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A SURVEY OF GERMAN WARTIME FOOD PROCESSING, PACKAGING AND ALLOCATION

FINAL REPORT OF THE FOOD MISSION

TECHNICAL INTELLIGENCE BRANCH, PROCUREMENT DIVISION

OFFICE OF THE THEATRE CHIEF QUARTERMASTER THEATRE SUPPLY FORCES EUROPEAN THEATRE.

Report prepared by

HEADQUARTERS THEATRE SERVICE FORCES, EUROPEAN THEATRE
OFFICE OF THE CHIEF QUARTERMASTER

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A SURVEY OF GERMAN WARTIME FOOD PROCESSING, PACKAGING AND ALLOCATION. PART II.

FINAL REPORT OF THE FOOD MISSION
TECHNICAL INTELLIGENCE BRANCH, PROCUREMENT DIVISION
OFFICE OF THE THEATER CHIEF QUARTERMASTER
THEATER SUPPLY FORCES EUROPEAN THEATER

(Part I published as separate volume)

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27 September 45

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Efforts are being made to obtain from America copies of the documents mentioned in this report, in which event they will, in due course, be available for inspection at the Documents Unit of the German Division, Board of Trade, Lansdowne House, Berkeley Square, LONDON. W.1.

Section VIII

FEEDING THE GERMAN ARMY

prepared by

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FEEDING THE GERMAN ARMY

Foreword

This story about what and how the German Army ate was written largely by those who had been directly responsible to the Berlin Headquarters for keeping the ever-present stew pots simmering in the field. Quartermaster records were destroyed to a considerable extent, but the available remains which survived the fall of Berlin were carefully examined. Alleged contents of several pertinant memos between high command generals about the growing food distribution nightmare contributed further information. Here the stupendous Stalingrad revival of Napoleon's original Russian ambition caught the German without the proper emergency rations because "to intimate that the Wehrmacht might be encircled is treason". This is said to have been an important factor in the Stalingrad rout.

Sketchy records were fortified in part, at least, by a series of interviews with former German Quartermaster officers and with prisoners of war recently released. The courtesies extended by our Third Army and Seventh Army Intelligence Officers was most helpful in those investigations.

A large number of further interrogations were made on all phases of this subject in various parts of Germany during the course of other technical investigations by this group. American combat troops who had tasted German rations, displaced persons who were being fed in part with captured enemy foodstuffs, former civilian employees of the Wehrmacht, returning German soldiers, and food technologists at several universities were included in this group. Their views are included with others in this report.

The German Quartermaster General, -foodwise, often was described as running a "two pot outfit". Obviously his food activities were not that simple but the German habit of eating thick foods and stews placed great favor upon that technique. It had the advantage of providing hot foods under almost every field condition, as the glycerin bath surrounding the cook pot held the temperature without burning. Unexpected combat conditions could delay the mess four or five hours without the troops having to

eat cold food. Some variety was achieved by mixing in different combinations of fresh or dehydrated vegetables, meats, and cereals potatoes being the base in many cases. The daily weighed quantities of food per man could be consumed by the unit at most convenient times and in combinations as preferred.

Another feature of the Quartermaster activities was planned foraging during the campaign. Platoons of skilled butchers equipped to slaughter animals which had been captured or shipped in, were an important segment of every regiment. When foraging was poor, larger withdrawls were made from quartermaster stocks. The German combat plan of fast movement was counted upon apparently to assure the capture of supplies and special foraging units were trained for this purpose.

The regular distribution of stimulating drugs to flyers and combat troops should be mentioned because of the general attitude of the soldier and his family on that procedure. "Better a live soldier full of caffeine than a dead one who hadn't moved fast enough", seemed to be the universal conclusion. One explanation for this view was the fact that many German civilians took caffeine tablets or other stimulants during the war years to offset fatigue from excessive working hours. The shortage of coffee was said to have contributed to the use of these drugs. The soldier received his stimulants largely in the chocolate-cola paste disc known as "Schoko-Cola". Vitamin C was also considered as a necessary addition to special combat or panzer troop rations. Fruit bars or hard candies were the vehicle for it.

Another development in German Army feeding which was forced forward because raw materials were limited, was the training and follow-up program for field cooks. The pre-war German habit of eating four or five times a day gave a real incentive toward qualification for the position of cook. He alone controlled the eternally bubbling coffee and stew pots. Specialists from Berlin carried on demonstrations regularly at the individual company kitchen, and popularly written bulletins came directly from Berlin to the cooks. Humorous cartoons often were used to illustrate the major points in the "Goulash Cannon"- the exclusive newspaper which the cooks prized as their own special line to the High Command.

Special rations in cans or other individual packages were distributed only to particular combat organisations whose services involved unusual physical exertion or hazards. Among the packaged rations, the German canned meats, canned boned hams, cheese and sausage can be classed as unusually good in quality. German Army chocolate was considered superior to the American by some of our troops. Its keeping quality was without doubt better than ours. The absence of milk was said to enhance its keeping qualities. Special manufacturing procedures for chocolate are described in Section VII.

The OKH directed a vigorous effort toward greater variety in the field mess by providing accessory attachments for the "two-pot outfit". These accessories were to provide means of cooking meat and potatoes separately and to creat other variations beyond the heavy soups and stews. Meat stretchers, crisp breads, cheese powder, dehydrated preserves, meat baked into a bread loaf, salt-free meat to be cooked with salt water at sea, powdered vegetable oils, dried egg pancakes, powdered butter, a belated 300 g emergency ration and various canned mixtures of meats, poultry rice and noodles were introduced experimentally late in the war. OKH also sponsored the synthetic fat program which resulted in reasonably tasty butter substitutes being made from coal. A substantial quantities of synthetic fat was purchased by the Wehrmacht as practical tests convinced them that these fats were assimilated satisfactorily.

The growing shortage of certain essential raw materials during the later war years taxed the ingenuity of the research staffs. German soldiers, according to eating habits and standards in the Reich , were well fed until these shortages developed.

The following report was prepared by Fräulein A. Spies, chief dietitian for the OKH and is based upon her broad personal experiences as well as other available information.

DESCRIPTION OF OVERALL ORGANIZATION FOR GERMAN ARMY FOOD AND RATIONS.

Organization.

The Ministry for Food had the chief responsibility for maintaining and controlling the German food supply. The head of this organization was the Reichsminister for Food and Agriculture. This Ministry was composed of a number of branches such as those for Nutrition, Animal Industry, Fats and Eggs. The Economic Branch had charge of the production and distribution of foods. The largest user of German Foods was the OKW (Oberkommando der Wehrmacht). The OKW was made up of the OKH (Oberkommando des Heeres), OKM (Oberkommando der Marine), and OKL (Oberkommando der Luftwaffe). The OKW had its own administration and officers for foods. This Administration Office worked directly with the Ministry for Food and submitted the food requirements of the OKH, OKM and OKL directly to this top agency. The regular Army and the Air Force received the same common foods. Special questions concerning food for the Air Force were submitted directly from the Air Force Administration to the OKH. (See Organization Charts I, II, and III)(and Appendix I, Item 58).

At the start of the war the Navy had its own independent food procurement organization but during the course of the war this power was largely transferred to the OKH. This change was necessary as the use of all foods had to be directed from a central point or organization. Later in the war the direction of food for other organizations such as the SS, the Labor Office, and HJ (German Youth) was incorporated into the OKH.

The Field Army was supplied with foods directly from Germany except when long supply lines or food shortages in Germany made it necessary for them to procure part of the food from the occupied territory to supplement that received from the homeland. The Home Army and the Reserves formerly had theit own procurement offices but during the war the German food economy demanded that they used foods from OKH store houses.

Organization Chart I.

German Reich
↓
Führer (Hitler)
↓
O K W

O K L (Göring) Airforce — O K.H (Keitel) Army — O K M (von Raeder) Navy

↓

V A
Verwaltungsamt

V/I Personnel — V/II Buildings — V/III Food and Procurement Amtsgruppe — V/IV Equipment — V/V Clothing

1. Planning
2. All around procurement
3. Cereal and livestock feeds
4. Quality control
5. Supply
6. Food for reserve and replacement troops
7. Education
8. Food economics and food science, including physiology of nutrition, development, food preparation.

Under V/III there were also eighteen Wehrkreis Administrations called WV which divided Germany into 18 areas. The WV had to see that the orders of the OKH were enforced.

There were 49 EVM's (administrations and warehouses) spread over Germany.

Under V/III were also the Institute for Cooking at Frankfurt, and the Institute for the Preservation of Fresh Foods at Munich. Wehrkreis and Army Instruction Kitchens and 60 field cook teaching groups were also under this office, as well as additional activities and responsibilities.

Butcheries, bakeries, mills, railroad kitchens, subsistence trains and ships.

Organization Chart II.

O K H (High Command)	R E M (Ministry for Food)
Amtsgruppe V/III	
Determined Army food and livestock feed requirements and submitted them to R E M. Also set up regulations governing procurement of material granted by REM	Had to secure and plan the production of material for German subsistance (both Military and civilian)
18 Wehrkreis Administrations (WV). It was their responsibility to see that OKH orders were carried out in their respective areas.	16 branches called Reichsstell[illegible] Their responsibility was to se[illegible] that the required amounts of food were produced and manufactured and distributed.
49 EVM's spread over the country. The Army received its food supplies directly from EVM warehouses under order from RKH.	**Sources of Foods** From government owed or private sources. All foods to be stored for the Army were sent to EVM warehouses.
	see Organization Chart III.

Organization Chart III

Sources of Foods

ommodity	Agriculture	Tradesmen	Factories	Army owned
Meat		sausage casings, animals	contract butchers, canned	stationary butcheries
arden and ield products	Fruit and fresh vegetables for home troops		canned, frozen and dehydrated fruits and vegetables	Herb gardens of troop kitchens. Fields near army training camps
ilk products			butter, cheese and milk	
ereals			cereal products factories and mills.	Army bakeries and army mills
otato roducts	Potatoes		Dehydrated potatoes, starch and pudding powder factories and distilleries	

The Ministry for Food had the responsibility of seeing that adequate amounts of the required foods were produced and available. This was carried out by sixteen committees concerned with different human and animal foodstuffs. They directed the production of food materials throughout Germany. The most important of these committees were:

1. Animal industry economics.
2. Animal industry-distribution.
3. Fisheries
4. Eggs-ecomonics
5. Butter-ecomomics
6. Milk and fat-economics
7. Potato economics
8. Cereals, grains and livestock feeds.
9. Vegetable production and processing.
10. Sugar-economics
11. Sweet and specialties such as nuts, marmalade, chocolate and candy.
12. Wine production.
13. Tobacco.

The EVM (Ersatzverpflegungsmagazine) (reserve food storages) received foods produced by both private and Army owned sources for storage in their warehouses. The EVM warehouses were located at strategic points throughout Germany. It was also the responsibility of the EVM to transport food and subsistence materials from the warehouses to the Field Army upon order by the OKH.

Under the administration of the OKH there were many branches. One of them was the Administration Office. This Administration Office (Verwaltungsamt) had at the beginning of the war five, and later eight, Office Groups (Amtsgruppen). Office Group III. (V/III) was called the Food and Procurement Office. This was the largest and most important Group. It was headed by a general (General Oberstabsintendant Boesler). This Group for Army food and procurement consisted of the following branches:

1. Planning.
2. Overall procurement
3. Special procurement for cereals for livestock (all animal feeds)
4. Quality control of foods.
5. Supply.
6. Subsistence for Home Army and Reserves
7. Education and instruction
8. Food economy and food science (including physiology and nutrition of subsistence, development, and preparation of foods).

Office Group III determined the requirements for foodstuffs and submitted them to the Ministry for Food. It also set up specifications for the purchase and quality of the foods so obtained. Under Group III were eighteen Wehrkreis Administrations. They had to see that the orders of the OKH were carried out. The 49 EVM warehouses in Germany were also controlled by the Wehrkreis Administrations. The foods shipped to the warehouses came from four sources, namely: the farmers, the trade, industry and from Army owned establishments.

Procurement.

In both peace time and during the war the Army food or rations (Wehrmachtsverpflegung) were figured on a basis of daily rations or portions which varied according to the type of activity of the soldier in the field and at home. The Planning Division of the OKH had to submit their food requirements to the Ministry for Food on the 1st of September for the coming year. In estimating these requirements considerations had to be given not only to the number of troops but also to the various activities in which they might be engaged. The Ministry for Food had to balance the Army food requirements against civilian needs, taking into consideration the available food supply. Army requirements were met inso far as possible.

The common food materials were obtained from various manufacturers who submitted samples for examination and testing by the OKH. The conditions upon which purchase and delivery would be made were set up by the OKH. The purchase and procurement of raw materials by the manufacturers was also controlled by the OKH and the committees of the Ministry for Food. Agricultural products were often obtained under contracts directly with producers.

Of the most important foods for the soldiers:

Bread - came from Army owned bakeries, private bakeries or from field Army bakery companies (for front line troops).

Meat - By contract with butchers, meat and sausage factories, and by Army butcher companies (for front line troops). (Appendix

Under the contracts of the OKH the manufacturers had to submit samples of the products which were then tested as follows: (1) organoleptically, by the OKH staff, and (2) chemically, by the Army Sanitary Corps. Animal or livestock foods were tested by Army Veterinarians. Production plants were frequently inspected by Sanitary and Hygiene officers, and in the case of animal products by Veterinary officers. Government chemists also tested the raw materials and the finished products to make sure that they were of good quality. Army officials checked delivery times and contracts to make sure that the manufacturer lived up to his agreement. When the manufacturer furnished faulty material he was held liable and had to make replacement.

The Army specifications for foodstuffs which were purchased are included in the Appendix I, Item 59.

Storage and Warehousing:

A complete description of German Army storage and warehousing specifications and requirements is included in Appendix I, Item 59.

Distribution and Transportation:

The distribution of foods for the Army was carried out under orders of the OKH which appeared in "Heeres-Verordnungsblatt", the newspaper of the OKH. (A sample of this paper is included in Appendix I, Item 6o). The current rations were described in the book "Einsatzwehrmachtsverpflegungsvorschrift".

Food Portion:

The food portions for a man per day consisted of: one bread portion and one of all the other foods (Beköstigungsportion). Maximum levels of food were guaranteed for use only when the activity of the troops absolutely demanded them. In peace time and at the beginning of the war the troops did not need this high level. Later in the war when available food supplies were reduced, the ration levels were also lowered. Under these conditions the soldiers needed the maximum level.

Noon and Evening Portions and Breakfast the Following Day which Equaled One Daily Portion (Peace time and at start of the war)

The bread portion consisted of:	High level grams	Normal level grams	Short level grams
Rye bread +)	650	550	500
or Rusk	375	375	375
or Knäckebrot	375	375	375
or Dauerbrot	600	-	-
or Flour	470	400	360
and baking salt	5	4.5	4

The "Other Foods Portion" (Beköstigungsportion) consisted of:	High level grams	Normal level grams
Meat +)	180	150
or Fish	500	500
or Eggs		
and Vegetables of different kinds		
and Extras +)		
" Condiments		
" Spices		
" Cheese, sausage, fish, etc. +)		
" Bread spread (fat) +)	50	30
" Beverages		
" Sugar and candy +)		

+) - foods that could different or varied in the high level.

At the beginning of the war the high level was for combat troops, the marines on board ship, and flyers of flying technical personnel. The normal level with normal bread ration was for the home troops and replacement troops for the Wehrmacht, also for training schools for replacement units where officers and enlisted men were trained. The normal level with reduced bread portion was given to all others in the Army.

Army personnel who did not eat at Army messes, received the normal level ration or the civilian ration. Prisoners of war were supposed to receive this same ration level.

In order to understand better the structure of the portions of other foods (Beköstigungsportion) the following list is presented. This list includes most of the foods commonly used by the Army, without the special foods.

Beköstigungsportion:

Meat	Fresh meat of different kinds, salted and frozen meats, with and without bones, smoked meat (beef, pork, or mutton, with or without bones) or smoked sausage, or bacon or fresh sausage, or boiled or fried meat, canned meat.	These were based on a weekly portion so that the amounts used each day varied
Fish	Salt herring, dried fish.	2oo grams
	Fish fillets	2oo "
	Fresh fish of all kinds.	5oo "
	Frozen fish with bones.	35o "
Eggs		3 only
Vegetables +)	Fresh vegetables, turnips, carrots, kohlrüben, white and red beets, kohlrabi, white, green, curled, or red cabbage, cauliflower, green beans, spinach, cucumbers, pumpkin	12oo grams
or	Frozen vegetables	44o grams
or	Canned vegetables (1/2 can)	425 "
or	Salted vegetables in barrels	4oo "
or	Sauerkraut in barrels or cans	45o "
or	Dehydrated Sauerkraut	5o "
or	" vegetables	6o "
or	Fresh potatoes	15oo "
or	Dehydrated potatoes	15o "
or	Peeled frozen potatoes (seldon used)	1ooo "
or	Dehydrated mushrooms	6o "
or	Backobst (dried plums, apricots, apples etc.)	15o "
or	Legumes (peas, beans, lentils)	15o "
or	Army dried soups (from peas or rye)	125 "
or	Milled grains (groats, grits, millet grain, oat flakes etc.)	1oo "
or	Wheat flour	2oo "
or	Noodles, spaghetti, macaroni, migetti, rogetti	15o "

+) The indicated amounts of vegetables represent one portion. One portion of these items could be served alone or mixed such as:

1/2 portion potatoes = 75o grams
1/2 " fresh vegetables = 6oo grams
1 vegetable portion

2/3 portion Lentils = 1oo grams
1/3 " potatoes = 5oo "
1 vegetable portion.

Extras: To make puddings:		
Pudding powder	2o	grams
and sweet evaporated skim milk	25	"
or fresh skim milk	.25	liter
and sugar	2o	grams
or Pudding powder mixed with skim milk powder and	55	"
sugar	2o	"
To make sweet soups:		
Pudding powder	2o	"
ans sweet evaporated skim milk	5o	"
or fresh skim milk	o.5o	liter
and sugar	2o	grams
or Fruit, frozen	17o	"

The extent to which "Extras" could be used was dependent upon directives from OKH ("Feldkost" and Speisenzusammenstellungen"- as discussed later on in this report).

Spices: Fresh flavoring herbs for soups	1o	grams
or Dried flavoring herbs for soups	2	"
or Fresh herbs	1o	"
or Dried "	2	"
or Salted " (mixed or unmixed)	2	"
or Caraway seeds	o.5	"
or Dried garlic (powdered)	o.o5	"
or Pepper	o.o5	"
or Paprika	o.1	"
or Pimento	o.1	"
or Nutmeg	o.o5	"
or Bay leaves	o.o5	"
or Cloves	o.o5	"
or Cinnamon	o.5	"

Other Flavoring Materials:

Salt	15	grams
and vinegar	0.ol	liter
or oil	o.ol	"
or Mustard	2.5	grams
or Tomato puree	1o	"
or Condimento (tomato,oil and spices)	15	"
or Tomato powder	4	"
or Egg substitute (Milei G)	5	"
or Full fat soya flour	5	"
or Yeast hydrolysate	3	"
or Hydrolysate from other sources	3	"
or Granulated meat extract	3	"
or Salted and spiced pickles (in cans and barrels	5o	"

Ingredients for Supper:

Canned meat	100 grams
or Corned beef	100 "
or Canned sausage	100 "
or Fresh sausage	120 "
or Smoked sausage	100 "
or Lard meat (Schmalzfleisch) -To spread on bread or for cooking	90 "
or Smoked bacon	90 "
or Hard cheese	100 "
or Soft cheese	125 "
or Sour milk cheese	150 "
or Cottage cheese	250 "
or Melted cheese	125 "
or Cheese powder	50 "
or Herring or other smoked fish	150 "
or Canned fish	120-180 "
or Oil sardines (2 cans)	90-125"
or Cod liver paste	110-135 "
or Fish paste	133-141 "
or Fish salad	195 "
or Eggs	2 only

Bread Spreads:

Butter) or Lard) or Margarine) or Butter oil)	40 grams
or Marmalade	200 "
or Hard marmalade (thick enough to be sliced)	150 "
or Marmalade powder	120 "
or Artificial honey	175-200 "

Could serve marmalade or artificial honey 6 or 7 days a month, at first, in addition to fat portion, but later instead of fat portion.

Beverages:

Roasted coffee	5 grams
and Coffee substitute	6 "
or Tea	2 "
or Pressed tea	1.5 "
or Tea substitute	4 "
or Cocoa (mostly for hospitals)	25 "
When possible, skim milk with coffee or cocoa	0.2 liter
When second beverage portion served after hard activity - skim milk	0.5 "
or Coffee or tea as above, served a second time.	
or Lemonade or mineral water	0.5 liter
or Alcohol-free juices	3/8 "

Sugar and Candy:

Sugar	4o grams
Drops and other candies	3o "

(Served four times a month to field army, navy, and air force).

Additional Food:

Bratlingspulver	not over	15o grams
Cooking fat		1o-15 grams

The soldier could receive from the Beköstigungsportion a whole portion of vegetables or one mixed portion composed of fractional portions of several items. In no case could the total amount be greater than one portion.

Once a month Menus were sent out by OKH in an effort to direct the use of available foods so as to make the most of the varieties and to provide tasty, nutritous and satisfying meals. Monthly inventories of foodstuffs in the warehouses were submitted to OKH by EVM. These reports were used as a basis in making out the Menus. However, in some cases theory could not be put into practice as foods had to be used, at times, before they spoiled and in other cases it was necessary to await the new harvest.

The bread, meat, cheese, fat, and sugar portions were quite stable, except when they had to be reduced. The frequency with which the vegetable portions could be served per month was quite elastic. This use of the vegetable portions was controlled by monthly directives issued by OKH, which were based upon available supplies, military strategy, the climate, and the number of men involved. These directives were issued in the following forms:

1. "Feldkostzusammenstellungen" for the field troops.
2. "Speisenzusammenstellungen" for the replacement and reserve troops.

For example, for thirty days:

Times served per month	Foodstuff	Size of portion
15	Potatoes	15oo grams
3	Legumes	15o "
1	Rice	1oo "
2	Grains and cereals	1oo "
1	Wheat flour	2oo "
5	Fresh vegetables	12oo "
	or Dehydrated vegetables	6o "
1	Sauerkraut	45o "
1	Salted vegetable	4oo "
1	Backobst(dried fruit)	15o "
Total 3o	portions in 3o days.	

The use of spices and other classes of foods were handled in the same way because often their use was dependent upon the kinds of vegetables being used. The kinds and types of the foods to be used were also dependent upon the supply, distance they had to be shipped, transportation facilities, climate and season of the year.

The transportation of the foodstuffs was handled by EVM and railways or ships were usually used although trucks were also employed. Airplanes were used under special conditions.

<u>Research and Development.</u>
(See Appendix I, Item 61).

During the changing course of the war many situations arose which called for the development of new foods by the OKH. At the start of the war many new foods and food sources were developed in order to provide an ample and immediately available overall food supply. Little action along these lines was taken before the actual start of the war In order to be assured of sufficient food it was necessary to include the small and medium sized food plants as well as the large manufacturers as sources of supply. As would be expected under these conditions many different foods were produced in small amounts by individual manufacturers, and which utilized raw materials which were available in only small amounts. These many different foods served to add variety to the diet of the soldier. Thus situation also served to decentralize the food industry and to protect the food supply in cases of bombing.

At first, the rapid expansion of the war fronts created a demand for large supplies of food. At this time canned foods were of major importance In Norway a monotonous diet of canned foods showed up the need for vitamins with the result that vitamin drops were developed and efforts were made to supply fresh vitamin-containing foods. Transportation difficulties and a shortage of packaging materials after the war had been in progress for some time made it necessary to expand the use of dehydrated foods. The shortage of tin plate, black plate, lacquers and aluminum for canned

foods accentuated the shift to dehydrated foods.

When the war progressed to Africa the development of foods suitable for warm climates became necessary. Stimulating and fast acting foods had to be provided for special troops and combat organizations.

As new areas were conquered new raw materials became available. Thus with the invasion of the Ukraine sunflower seed, buckwheat, and corn provided new food materials. Works had to be done on methods of incorporating them in the German Army rations. On the other hand shortages of certain raw materials developed, as they could no longer be imported. Thus substitutes for soya beans, oils for margarine, protein and many other materials had to be developed. Often in the substitution of new raw materials products of poor keeping quality resulted and extensive research was necessary in order to determine the cause of the trouble. As the war situation became worse for Germany, such as the defeat at Stalingrad, an acute need for light weight concentrated emergency rations developed. It was reported that as early as 18 months before Stalingrad one of the prominent men in the OKH suggested that such emergency rations should be developed but he was severely censured for being pessimistic about the capabilities of the German Army.

The shortages of protein and fats were solved in part by continuous investigations that were carried on in the search of replacements for these materials. Efforts were also made to improve the quality of animal foods so that they could be used for humans. This diversion of animal foods for human consumption in turn caused a shortage of animal feedstuffs. Research work to develop new sources of protein from yeast, from sulfite liquor and wood sugar, soya beans, lupine seed, chestnuts, rape seed and sunflower seed press cake, cottonseed, dehydrated whey, recovery of blood from slaughter houses was carried out with more or less success. When a new source of raw material was found research work was then carried on, in cooperation with manufacturers to develop the most effective production methods. In carrying out this work, guided by experts of the OKH, new products were approved and procured.

Because of the extensive activities carried on only a brief mention of some important points can be made in a report such as this.

Due to the increasing bombing terror, the enormous destruction of factories and transportation systems, the decreased transportation capacity, by loosing large parts of both the occupied countries and the homeland, the immediate problems of taking care of fleeing and homeless people, many of the food materials used up to this time were no longer available. There were other food materials that had to be simplified, extended or altered in their composition. The watchword was "TO SIMPLIFY". This simplification program was accentuated by the fact that more and more people were taken from industry and the OKH for service in the Army. The overall staff of the OKH was cut 5o percent, and that of the Development Section of OKH by 6o percent.

For some food products "frame formulae" or base recipes were set up to allow for the substitution of materials and ingredients. All factories making a certain product had to follow the "frame formula". These formulae were set up so as not to conflict with existing procurement contracts and specifications. Some food products were abandoned because they were not economical of packaging materials and shipping space on the basis of their nutritive value. In other foods, ingredients which served more or less as filling material were eliminated and the nutrients were concentrated in order to reduce volume. The procurement of foods in some cases was abandoned when factories and machinery were destroyed as new equipment could not be obtained. As examples of the simplication of foods (1944-1945) the following products may be mentioned:

Bratlingspulver:

As the overall food situation deteriorated the production of bratlingspulver was increased, although normally this product was not considered to be a well liked food. By means of bratlingspulver, food of good nutritive value, although of poor palatability, and appearance, could be provided in an altered form which was acceptible to the consumer. Such foods could also be

used in the Army kitchen without changing the usual form of the food. The volume or bulk of bratlingspulver was decreased by making it in a more concentrated form. The ingredients which provided protein were increased from 16% to 40% (2 1/2 times). By this means the amount of bratlingspulver produced was reduced 60% without changing the amount of protein involved. The Army kitchens were instructed to mix this concentrated bratlingspulver with 2 1/2 times the volume of cereal or potato products. The advantage of this concentrated bratlingspulver was in a more successful use of "frame formulae" and a saving in transportation space.

Egg Substitues:

Egg substitutes were given up in order to have the raw materials such as dried milk powder, available for other purposes.

Powdered Sauces:

Powdered sauces such as tomato sauce, onion sauce, etc. were given up in the interest of simplification.

Hard Marmalade:

Hard marmalade was abandoned in favor of more paste marmalade as it required too much fruit pulp and pectin.

Mustard:

Wet mustard was given up because its nutritive value and importance did not justify the expenditure of space and packaging materials under this situation. Only dry powdered mustard was allowed.

Pickles and Mineral Water:

Were given up because they were too expensive from standpoint of transportation and shipping weight.

Special Army Rations:

Efforts were made to simplify all special Army Rations except those for the flying crews and submarines.

Biscuits:

Such as butter cakes, soya meat breads, Kraftkeks (20% protein) were all made together under one "frame formula".

Fruit Slices and Fruit Bars:

These were simplified in favor of a sugar covered bar made according to a "frame formula" of Sarotti. The coating was made of hard fat without cocao and with sugar and ground roasted peas. The filling was made mostly of dried fruits with just a little fat. The ingredients formerly used were thus made available for Wehrmachtsschocolade. This simplification also permitted more fruit pulp and pectin to be used for marmalade.

Studentenfutter (Food to be eaten out of pocket):

Made of raisins, dried apricots, plums and nuts (almonds) was stretched by 50% by the use of puffed and roasted cereals.

Marzipan:

Was given up due to shortage of nuts and seeds.

Stimulating Foods:

Such as Hilkola, Koffinos, Mokkakugeln were given up in the interest of simplification and to increase the production of Schokokola and Glykolade.

Schoka-Tropa:

Given up as there was no need for it after the African Campaign was lost.

Candy:

Weinsaurebobons (drops), peppermints, wheatdragees and gums were given up due to lack of sugar.

Evaporated Milk:

Changed over to milk powder in order to conserve packaging materials and shipping space.

Mixed Canned Foods:

Were first developed to save half of the cans required by evaporating 50% of the liquid before the cans were filled. This product was later dehydrated in order to eliminate the use of cans altogether.

Tests Used to Determine Acceptance of Foods and Their Evaluation.

When a new food or a replacement food material was developed it was prepared and served in the research kitchen of the OKH and examined by the staff. It was evaluated organoleptically on a point system in which the flavor, appearance, consistency and other properties were considered. Advice of the tasting panel was followed in making changes or improvements in the product.

After being tentatively approved by the OKH research kitchen the food was tested on a large scale under practical conditions by many Army Institutes (2o-25) and the Cooking Institute. These agencies evaluated the product on its practicability and acceptance. If the product was considered satisfactory at this point it was next tested in Army training Centers on large numbers of troops. All the results of these tests were returned to the OKH for their final decision. In most cases the approval of the troops was followed in determining the final acceptance of the product but during the last part of the war the product had to be used in many cases regardless of its acceptance by the troops.

In addition to the practical tests there were chemical tests such as proximate composition, vitamin content, keeping qualities in storage, effect of air, high and low temperatures, and packaging requirements. Animal tests were made on some food products (such as vitamin tests). The chemical and physiological tests were made by the Institutes of Hygiene and Veterinarian Science.

As an example of the test methods used, a test on an important Army food item, the Army bread, is presented. Such a test as this might be carried out by the Institute for Baking or by an Army baking company.

The purpose of the test to be described was to determine the amount of rapeseed press cake flour, a German source of protein, that could be satisfactorily used in bread. The rapeseed press cake itself has a poor flavor and appearance. The purpose of using it was to stretch out the bread flour, and to utilize a bad looking food product in a way that it was covered up so as not to be objectionable.

Baking Research on flour extended with Rapeseed Press cake:

a. Containing 5% added rapeseed press cake meal) percent
b. " 10% " " " " ") based on flour, not finished bread.

The rapeseed press cake meal was leached with water before using in order to remove the bitter taste. Rapeseed flour has good swelling properties. Doughs from both (a) and (b) were of good firmness. They had a slight coffee-like odor and a slight bitter taste. Sour dough was added as a leavening agent.

Demanded: 14 loaves of bread of 1.5 kg wt. Wt. of dough for one loaf equaled 1700 grams.

Dough (a)	Dough (b)
11.700 kg sour dough(48%)	11.700 kg sour dough(48%)
7.400 rye flour	6.685 kg rye flour
0.715 kg rape flour (5%)	1.430 kg rape flour (10%)
3.735 kg water	3.735 kg water
0.250 kg salt	0.250 kg salt
23.800 kg total	23.800 kg total

The dough did not rise very well as normally it took 20 minutes but the above batches required 50 minutes. Therefore the crust was split both before and after baking. After baking it was again evident that the breads did not rise too well, particularly the batch with 10% rapeseed flour.

Results of Test:
(a) - 5% added rapeseed flour:

volume	Point score (highest)	Actual score	Comments
1. Form or shape	(3)	3	normal
2. Crust:			
Thickness	(2)	2	good
Brown color	(2)	2	good
Surface	(2)	1	some cracks
3. Crumb			
holes	(5)	3	good
elasticity	(4)	4	sufficient
uniformity	(2)	1	slightly bitter
4. Taste			
chewing	(3)	2	no comment
acidity	(4)	4	normal
Total	(30)	24	satisfactory

(b) - 1o % added rapeseed flour:

	Point score (highest)	Actual score	Comments
1. Form, volume	(3)	2	flatter than normal
2. Crust:			
thickness	(2)	2	good
brown color	(2)	2	good
surface	(2)	1	cracked
3. Crumb:			
holes	(5)	3	compact and dense
elasticity	(4)	3	not objectionable
uniformity	(2)	1	sufficient
4. Taste:	(3)	1	bitter, not good
chewing	(3)	2	not objectionable
acidity	(4)	4	normal
Total	(3o)	21	not satisfactory.

Conclusions:

If it is absolutely necessary to use rapeseed flour in Army bread it should not be used in amounts greater than 5 % if a satisfactory bread is to be produced.

THE GERMAN ARMY RATIONS - ALL TYPES

Nutritive value:

The types of food used by the German Army were determined by experiences in war and peace time through practical tests, untiring scientific research, and observations. However, the German economy was a limiting factor in so far as carrying out some theories in practice was concerned. Under normal conditions the Army received good nutritious food, which when properly cooked, was varied and tasty. Common everyday foods and not luxury items were used. All of the latest knowlege of food science, especially as regards vitamins and minerals was considered but not overemphasized.

The nutritional levels of the rations approached those set forth by Prof. Voit in his "Voit'sche Kostmess" (food measures). Prof.Voit, who taught at the University of Munich during the last century recommended the following food intake, per 24 hours for the average person doing physical work:

Calories --- about 3ooo, derived from:
1. 15o grams protein
2. 5o " fat
3. 5oo " carbohydrate.

Prof. Max Rubner, a contemporary of Voit in Munich recognized the importance of considering the difference in food requirements of the individual as influenced by age, sex, body weight, temperature, climate, energy requirements of different types of work and other undetermined factors. These requirements as set forth by Rubner were considered in the rations for different types of Army troops. The advisory group of the Army Medical corps, consisting in part of many prominent scientists, recommended that the daily food requirements of a soldier be set at 3600 - 4000 calories from the following sources:

1. 100-120 grams protein
2. 80-100 grams fat
3. 500-600 grams carbohydrate.

The daily vitamin C requirement was set at 50 milligrams and was supplied in part by vitamin drops (V drops). In addition advice was given that potatoes and vegetables should be handled with care in order to prevent an excessive loss of water soluble vitamins. It was considered that adequate amounts of the other vitamins were supplied by the foods themselves, e.g. vitamin A from butter or margarine enriched with carotene, and vitamins B and E from Army bread made from 82% extraction rye flour (later charged to 94%)

The Committee on Subsistence for the Wehrmacht composed of scientists, certain government officials, and men with long practical experience, met every three to four months to discuss changes in the subsistence of the Army. It was this group that decided the changes that were made in the Army rations from time to time, and which were necessary during the course of the war. Of the various nutritive elements, major emphasis was placed on protein as it could not be replaced by other nutrients. Under wartime conditions only the combat troops could receive the recommended 100 grams of protein daily. It was recommended that 40-50% of the protein be of animal origin as it was considered essential for men engaged in active and heavy work. In all Army rations the actual biological value of the protein was considered on the basis that the closer the composition of the protein came to that of that of the body the higher its value.

By this means the required amino acids could be supplied. In spite of the fact that the comparative biological values of animal and vegetable proteins were known, it was not possible to meet this standard in practice. Actually animal protein could only be supplied to the extent of 35% in the rations of the front line troops and 20% in the rations of the rear line troops.

Foods rich in fat and carbohydrates were considered to be good sources of energy for men doing continuous or routine work. Fats were also given consideration on a basis of their digestibility and their content of other substances such as vitamins. They were also important because of their influence in providing a feeling of satiety, and their high caloric value. They were visible when spread on bread and also present in an invisible form in sausage, meat and cheese. Soon after the war started the fat ration had to be reduced below the recommended level. Therefore the carbohydrate content of the ration was increased as it was easily digested by men doing manual work and could also be substituted in part for the fat.

Near the end of the war there were questions regarding the mineral metabolism in the body. Research work on the fortification of bread with calcium was considered but was not carried out as it was thought that adequate amounts were supplied by the other foods and that in a fortification program unscrupulous manufacturers might adulterate the bread.

Changes in the Nutritive Value of Rations During the Course of the War.

It may be seen from the composition of the different types of rations that the type of activity in which a soldier was engaged governed the amount of food which he received. In the face of decreasing food supplies during the course of the war an effort was always made to supply the combat troops with adequate amounts of high quality protein and fats. This meant the food available for troops doing less active work was reduced. However, in order to spread the burden of reduced food supplies as equitably as possible the various groups of soldiers were reclassified so that all groups would have a small reduction in food rather than

giving some groups a small reduction and others a large reduction.

As the war fronts expanded in the North and South the four food levels of the Army rations were divided and adapted to the climate, as follows:

1. For the North (North of 66° latitude), Meat, bread and fat added.
2. For the South (Southern Russia, Crete, Southern Italy, Libia). Fat and meat content reduced and sugar and noodles increased.

Now instead of having four levels of rations these variations resulted in twelve ration levels.

In table I may be seen the important changes in the food groups of the Army Rations during the course of the war. More detailed information on the specific food items of the rations are discussed previously in Part I. Groups of soldiers and military units which received added food under specific regulations are shown as follows:

Translation from "Wehrkreis" Bulletin No.lo, 9 March 1945. § 263. Jurisdiction for Armed Forces Rations.

I. Combat Rations (G-rations) are given to:

Members of the Army and Waffen-SS who are combat effective according to annex 1 and who are in a combat area determined by the Army, including supply and maintainance units which draw rations from their units as well as divisional staffs.

In the Air Force:

a) Flying personnel in action against the enemy including transport planes, flying personnel of courier formations and of meteorological observation planes.
b) The crews of vessels and boats belonging to the Air Force, while at sea and the first 21 days in port.
c) AAA units, parachute and air signal units which are in combat areas determined by the Army.

In the Navy:

a) The crews of warships at sea and the first 21 days in port.
b) Crews of special types of U-boats for more than 21 days as determined by the OKW.
c) Marine units in action in a combat area determined by the Army and which are combat effectives (annex 1)

Units and organizations employed in action under the direction of the Armed Forces:

The members of units which are in action and are combat effectives, for the duration of their employment in action, as ordered by the unit commander.

Members of units which, for one week, are undergoing refresher courses in the Army Group areas and air force units in the Zone of the interior.

Normal Ration (N-Ration):

a) Members of all other units if they do not draw the short G or N-ration.
b) Auxiliary personnel and all classes of helpers who can claim to be supplied by the Armed Forces outside of the Reich territory and in Army Group areas.
c) German and non-German members of units and organizations outside of the Armed Forces (including OT) who are employed by the Armed Forces, who are billeted as a unit and who are qualified to receive Army rations.
d) Miners, who, during the course of pre-military training, are temporarily housed in barracks, camps or training grounds.

Table I.
War Food Levels from 1939 to 1945.

Levels	Daily				Weekly			Calories
	Bread	Fat	Marmalade+ Artificial Honey	Sugar	Meat	Bratlings-pulver	Cooking fat	per day
	grams	grams	grams	grams	grams	grams	grams	
Big level	650	50	40	40	ca.1750	150	10	4200
Normal level	550	30	40	40	1400	150	10	3800
Normal with reduced bread ration	500	30	40	40	1400	150	10	3600
1940 - 1943								
I	600	40	40	40	1350	40	15	3700
II	600	40	40	40	1150	40	15	3400
III	500	40	40	40	1000	80	15	3050
IV	500	40	40	30	800	60	15	2700

Additions or Reductions from the above were made for the North and South regions. Thus North and South ration levels were developed.

1943 - 1945

Levels	Daily				Weekly			Calori per day
	Bread	Fat	Marmalade + Artific. Honey	Sugar	Meat	Bratlings-pulver	Cooking fat	
	grams	grams	grams	grams	grams	grams	grams	
I	7oo	42	4o	3o	1o5o	4o	15	345o
II	6oo	4o	4o	3o	8oo	6o	15	3ooo
III	6oo	3o	4o	3o	66o	8o	15	28oo
IV +)	5oo	25	4o	3o	4oo	11o	15	225o

+) - seldom used for troops. More for OKH women workers in offices etc.

1945

Combat level	7oo	4o	4o	3o	1ooo	8o	15	36oo
Normal level	5oo	25	2o	15	65o	8o	15	24oo

The Normal Ration, Short and Without Extras:

The normal ration minus:

Bread - 2oo grams a day
Meat - 3oo " a week **for:**
Fats - 5 " a day

a) Members of Headquarters and officers (soldiers, employees and auxiliaries) who are employed in light work or office work in the Reich territory and the Protectorate (excluding Army Croup Area).
b) Men supplying their own rations who make use of their right to Army rations. If employed on outside duty they are entitled to the Normal ration. Men supplying their own rations who consume only the noon meal in an Army mess are still covered by existing regulations.

III. Regulations extra rations will be given in addition to the regular ration as follows:
1. General extra meat ration (only with N-ration)
a) As extra rations for newly activated units or those who are being rehabilitated for action in the near future.
Units (except permanent offices) in the Army area outside Army Group area.
b) As extra rations for a course of training.
Schools and training units who are predominantly on outside duty, as determined by the OKW.
OCS at Army posts in Germany and the Protectorates of Bohemia and Moravia.
Special training courses for officers, officer candidates and Nco's which are concerned with combat training of all ranks.

c) As extra rations for maintenance services, as determined by the units according to OKW regulations.

d) As extra ration in mountains over 12oo meters high. e) As extra for flying personnel not in action against the enemy but otherwise on flying duty.	plus 25o grams of food per week.

2. Extra rations for miners +)(only granted in addition to N-rations)		daily 2oo grams bread and weekly 3oo g meat.
a) male members of the class of 1927 and younger, for 4 months after first employment as well as male Labor Service men working for the Army. Air Force auxiliaries only on medical orders if they are older than class 1927	To be eaten with bread	daily 15 g fats, butter if possible daily 2o g artificial honey, daily o.3 l fresh skimmed milk (if supplies are possible

b) All male and female members of class 1924 and younger who have a right to Army supplies, as well as Labor Service units working for the Luftwaffe.	Daily loo g bread weekly 6o g meat daily 2o g artificial honey.

3. <u>Flying personnel extras</u>

Crews of planes in action against the enemy, including transport planes.	Weekly loo g meat.

4. <u>Air Force personnel extras.</u>

Only if the technical personnel is carrying out specially ordered work and if they are in charge of keeping flying units ready for action.	Extra rations up to the level of G-rations

Granted by the Supreme Commander of Air Fleets with quarterly consumption reports to OKW/VA.

5. <u>Extras at sea.</u>

Crews of warships at sea in action against the enemy. a) U-boats	Weekly 35o g meat.
b) Outpost boats, mine sweepers, U-boat destroyers, as well as net boats, boom breakers etc. in action.	Weekly loo g meat

6. <u>Equalization Extras</u> +)

Members of the Armed Forces and the Organization Todt who are employed at very heavy labor on concentrations, in shops or armaments industries will obtain extra rations by order of the territorial commanders to make up for the difference between their regular Army rations and the ration for civilian laborers doing similarly heavy work.

III. Permission can be given for:

Main effort extra rations:

For special cases and extraordinary circumstances requiring special rations, the OKW can grant extras. These extras can be granted only within the limits of the supplies issued.

In General:

All previous regulations regarding rations and extra rations are rescinded. The following regulations will remain in effect:

+) The issue of extras 2a and 6 precludes the issue of any other special rations. The other extras can be cumulative if the conditions meet the requirements.

The demarkation of the above groups receiving supplemental foods was changed from time to time in order to provide more food for the front line combat troops. In addition to the changes in the food levels in the rations as shown in table I, additional changes were made as follows:
legumes were reduced from 18o to 15o grams,
noodles and macaroni from 18o to 15o ",
potatoes from 15oo to 12oo grams and later to 1ooo grams.

As the quantity of food materials decreased and efforts were made to stretch them out their quality and caloric value decreased. For example, early in the war full fat soya flour was used as an ingredient of bratlingspulver but later on the soya flour was not available, which resulted in a decrease in the fat and protein content of this product. Likewise the fat content of the Army dried soups was reduced from 12% to 6-8%. The milling grade of rye flour for the Army was increased from 82 to 94 percent with an accompanying decrease in caloric value. The amount of available pork also decreased and that which was available was of poor quality Most of the hogs in Germany were shipped to Poland because during the Polish campaign most of the hogs there were killed. This left a surplus of hog food in Poland so German hogs were sent there to be raised and propagated in order to provide additional pork during the next year. A shortage of live stock food in Germany also made it necessary to kill many cows and oxen before the correct time. It was normally planned that the cooking fat needed would be supplied by fat from meat in the Army ration. This was possible when good grade beef and pork

was available and when it was cooked in one kettle in stews. Poor grade meat did not provide the amount of fat necessary to prepare many of the cooked dishes. For example, with only 15 gr. of fat per week Bratlinge could be fried only one or two times. Thus some of the butter and margarine, provided for use as bread spread, had to be used in cooking. This caused a shortage of bread spreads which were necessary on the rough dark bread in order to make it palatable. (7oo or 8oo gr.of bread per day were supplied to the new recruits at this time. This increased the need for bread spreads). New problems were always arising. One solution to this problem was the use of a warm cereal in the morning. however, in the coarse rye flour without fat did not make a very palatable product. Sometimes it was possible to use rye grits instead of part of the bread flour ration to make this product.

To overcome the shortage of bread spreads, products with bratlingspulver as a base and containing meat and fat were developed for this purpose. These were quite tasty when prepared by good cooks.

The use of a warm meal in the evening also helped to overcome the problem of a reduction in the quality and amount of available foodstuffs. By this means it was possible to supply 3o-4o gr. of meat and one half the vegetable rations on 15 days a month in the form of this warm evening meal. This change brought about an increase of 5o percent in the carbohydrate content of the ration without an increase in bread, sugar, marmalade or bratlingspulver, as the so-called vegetable portion of the ration also included such things as rice, grits, noodles etc. as shown in part I. The recommended caloric content of the ration could be attained but the proportion of protein to carbohydrate was always unfavorable.

Calories for the Military and Civilians in the middle of the war were allowed as follows:

Military:	Combat troops	36oo to 42oo calories
	Rear line troops	35oo "
	Troops in the home area	3o5o "
	Army personnel who did not eat at regular messes, and OKH	24oo "

Civilians:	People doing heaviest types of work	4000 to 4200	calories
	People doing heavy work	3500	"
	People working overtime and night workers	3000	"
	All others	2400	"

Typical Daily Menus for Common Soldiers and Special Groups:

In the structure of the German Army Ration the composition of one portion, such as the vegetable portion (including grits, rice, noodles etc.) was such that it might be good or bad. For example, a poor cook might serve 450 gr. of sauerkraut one day (a very light portion) or 1500 gr. of potatoes another day (a very heavy portion). Thus the daily ration might have a small or large caloric value depending upon how the mess was managed. In order to avoid such situations the Speisenplan was developed to serve as a guide. It was important that this plan be followed in order to make the best use of the weekly food allotments and apportion them throughout the week to provide well belanced and tasty meals. In a simpler system, developed by the author, a point system was used so that it could be used successfully by the inexperienced person. In this system, each foodstuff was given a number depending upon its caloric value, e.g. 50 calories equal 1.

A good Speisenplan had to take into consideration the time of the year, combinations of available food stuffs, a good balance of calories, and suggestions for new dishes. When a cook followed such a plan the men were given meals that were well balanced and adequate. A typical Speisenplan is shown in tabel 2.

Table 2.

SPEISENPLAN FOR AUTUMN MONTHS.

Meat	Vegetables	Extras
	Dinner	
Fried beef	Leek, salt potatoes	Fruits
Pork belly +)	Turnips, potatoes	
Bacon	Potatoes	Sauerkraut salad
Mutton +)	Cabbage, potatoes	
Minced meat	Salt potatoes (boiled potatoes)	Cucumbers
Bratlinge	Mixed vegetables, salt potatoes	
Boiled beef	Horse radish sauce, potatoes	
Salted meat	Sauerkraut, mashed potatoes.	
Goulash	Maccaroni	Tomatoes
Blood sausage +)	Potatoes, apples, onions ("shoe maker dish")	

t dumplings	Salt potatoes and white sauce	Celery salad
led beef +)	Mixture of vegetables (beef stew)	
tlinge	Red cabbage, whole boiled potatoes	
ced pork	mashed potatoes	cucumber
led beef +)	Curly cabbage, salt potatoes	
ton ragout	Noddles	
nkfurters	Potato soup	Grit pudding with fruit sauce
ed sausage	Red cabbage, salt potatoes	
ked bacon +)	Cabbage, potatoes ("Hunting cabbage")	
ed meat dumplings	Spinach, salt potatoes	
led pork +)	Turnips, potatoes	
laden (from beef)	Green cabbage, salt potatoes	
on +)	Groats soup	cucumber
t loaf	Carrots, salt potatoes	
led pork	Sauerkraut, mashed potatoes	
ted meat +)	Onions, potatoes (a Navy food)	
tlinge	Salt potatoes	
sage and grits	Creamed potatoes	Cabbage salad
ed pickled meat	Potato dumplings	Red beets
led beef	Noodles	

A stew made in one pot.

<u>Supper and breakfast the following morning.</u>

sh sausage(1P)	bread and beverages and sometimes a marmalade
tage cheese with chives (1/2P), Cheese (1/2P)	
nkfurters (1/4P) in potato soup (1/2P), Fresh sausage (1/4P)	
ked bacon(1P)	"
d cheese (1P)	"
kwurst (1/4P), potato salad (1/2P), liverwurst(1/4P)	"
ting sausage (1P)	"
ted cheese (1P)	"
ed potatoes (1/2P) with red beet, bacon(1/4P), sausage (1/4P)	"
tage cheese with herbs (1/2P), bacon (1/2P)	"
od sausage (1P)	"
d cuts (1/2P), cucumber, spread sausage (1/2P)	"
sage and grits (1/4P), whole potatoes (1/2P) with onion sauce bacon (1/4P)	"
t cheese (1P)	"
erwurst (1P)	"
grit soup (1/2P) with bacon (1/4P), bockwurst (1/4P)	"
tage cheese with chives (1/2P), Bacon(1/2P)	"
d cuts (1/2P), cheese (1/2P)	"
d cheese (1P)	"
caroni (1/2P), blood sausage (1/2P)	"

Cheese (1P)	Bread and beverages and sometimes a marmalade
Smoked bacon (1P)	
Hunting sausage (1P), radish	
Cottage cheese with herbs (1/2P), Hard cheese (1/2P)	"
Liver sausage (1P)	"
Ham sausage (1/2P), creamed potato (1/2P) melted cheese (1/4P)	"
Cold cuts (1/4P), fried potatoes (1/2P), sausage (1/4P)	"
Soft cheese (1P)	"
Bockwurst (1P), radish	"
Potato salad (1/2 P) with celery and apples, bacon (1/2P)	"

P-one whole portion.

Special troops and army groups were given special rations as follows:

Summary of Special Rations, their Composition and Use:

I. Special Rations for Pilots:

a) Starting Provision: (presumably eaten before start of flight) (The High Commander of Air Force had ordered that tests be made to develop new starting provisions for pilots at the Institute for Cooking Science).

- 1/2 liter of whole milk or 1/3 can of condensed or evaporated milk.
- 1 egg
- 25 gr. butter
- 25 gr. grits or wheat, or rice or oats
- 2oo gr. white bread
- 65 gr. "Rösta" cakes.

b) Plane Provision: (additional food to guard against fatigue and exertion during flight).

- 5o gr. bitter kola chocolat
- 5o gr. milk-moccha-Glycolad
- 25 gr. Dextro-Energen or
- 8o gr. fruit slice or
- 8o gr. "Student food" (candi mixed nuts)
- 3o gr. spear mint or sour drops or lemon or mixed bon-bons.
- 5o-1oo gr. cake or 8o gr.soya c

c) Plane Provision: (Used for flights lasting longer than six hours. Instead of this provision sandwiches may be taken). Composition the same as in b)

d) Plane Provision: (Delivered when starting out on flight of more than ten hours).

- 12o gr.fresh meat with bones c
- 1oo gr.preserved sausage or smoked sausage,
- 5o gr. cheese
- 2o gr. cocao or
- 2o gr. coffee
- 5oo gr. fresh fruits or
- 28o gr. canned fruit

<u>Pilots Provision in Case of Emergency Landing</u> (when flying over the sea or waste districts. in case of single jump).	loo gr. choca-cola 2o gr. chewing gum
<u>Emergency provision Container:</u> (for planes (desert) for six days).	1 can mutton and rice- 25o gr. 2 cans mutton " green beans - 25o gr. each. 4 packages of sliced fruit of 8o fr. each or 1 can canned fruit containing 25o gr. 6 packages "Kössen" bread, each containing 4 slices, 2 cartons choca-cola each containing 1oo gr. 1 can vitamin drops (5o gr.bag) or 22 gr. roll). 4 packages Dextro Energen.
<u>Emergency Provision Container:</u> (For planes (winter) for four days).	1 portion "Kössen" bread containing 375 gr. 2 portions field zwieback of 25o gr. each. 4 cans pork - 2oo gr. each 2 cans lard-meat preserves of 2oo gr. each, 8 portions Maggi soup cubes of 5o gr. each. 3 cans choca-cola of loo gr. each lo portions Dextro-Energen, 5oo gr. soup cubes.
<u>Winter Emergency Equipment:</u> (accessories for seat-parachutes).	1 can pork fat of 2oo gr. 1 can choca-cola of loo gr. 25o gr. field zwieback
<u>Emergency Provision Container:</u> (for rescue tube boats)	4 packages field zwieback of loo gr. each 2 cans choca-cola of loo gr. each 1 package Dextro-Energen of 5o gr.
<u>Sea-Emergency Provision Buoy:</u>	a) <u>Small container:</u> 1 package dehydrated fruit of 15o gr. 1 carton choca-cola of loo gr. 1 bag chewing gum of 2o gr. b) <u>Large container:</u> 45o gr. "Kössen bread"(loose).

II. Special Rations for Parachute and Air-Landing Troops:

a) Paratrooper Provision "South": (provision for 48 hours).

- 250 gr. fresh sausage (beer or hunting sausage) in 4 aluminum bags,
- 150 gr. cheese in 2 aluminum bags,
- 250 gr. field zwieback in 2 linen bags
- 500 gr. soya-meat-bread in 5 packages
- 200 gr. choca-tropa in 4 bars,
- 150 gr. Dextro-Energen in 3 packages,
- 1 bag chewing gum.

b) Paratrooper Provision "North": (provision for 48 hours).

- 400 gr. smoked bacon in cellophane,
- 200 gr. preserved sausage (Landjäger)
- 250 gr. field zwieback in 2 linen bags,
- 500 gr. soya-meat-bread in 5 packages
- 200 gr. Glycolade in 4 packages
- 100 gr. Marzipan in 2 cubes
- 100 gr. Dextro-Energen in 2 portions,
- 1 bag chewing gum.

III. Special Rations for Tank Troops:

a) Tank Troops Special Equipment:

- 1 can mixed preserved (850 gr.)
- 500 gr. knäcke bread or
- 600 gr. preserved bread B,
- 200 gr. lard-meat,
- 100 gr. choca-cola
- 25 gr. pressed coffee (15 gr. coffee beans, 10 gr. sugar).

b) Tank Troops Additional Provision: Same as for combat troops of the infantry (see VI)

IV. Special Rations for Scouting Units (Jagdkommandos)

a) For absence of 2 days: 1st day: dinner:

- 180 gr. bacon or
- 180 gr. preserved meat or
- 200 gr. canned pork

1st day: supper:

- 110 gr. preserved sausage or
- 120 gr. preserved meat or
- 120 gr. canned sausage or
- 150 gr. canned fish,
- 375 gr. knäcke-bread,
- 3 gr. tea tablet,
- 10 gr. sugar,
- 50 gr. choca-cola,
- 2 cubes of broth.

2nd day: dinner:

Same as on 1st day.

2nd day: supper:

125 gr.tube cheese or
120 gr.preserved meat or
120 gr.canned sausage,
375 gr.Knacke bread,
3 gr.tea tablet,
10 gr.sugar
50 gr.choca-cola,
2 cubes of dehydrated broth
100 gr.dehydrated fruit.

b) For absence of 5 days: 1st day: dinner:
200 gr.canned pork

1st day. supper:

110 gr.preserved sausage or
120 gr.preserved meat or
120 gr.canned sausage or
125 gr.tube cheese or
90 gr.lard-meat or
150 gr.canned fish
375 gr.knacke bread,
25 gr.pressed coffee,
10 gr.sugar,
50 gr.choca-cola.

2nd day: dinner

50 gr.soup ready for cooking
200 gr.canned beef or pork.

2nd day: supper:

110 gr.preserved sausage or
120 gr.preserved meat or
120 gr.canned sausage or
125 gr.tube cheese or
150 gr.canned fish,
40 gr.lard (spreading)
600 gr.army preserved bread,
25 gr.pressed coffee,
40 gr.sugar,
25 gr.Dextro-Energen or
30 gr.drops,
50 gr.tartaric acid bon-bons.

3rd day: same as 2nd day except
375 gr.Knäcke bread instead of
600 gr.army preserved bread

4th day: same as 2nd day

5th day: same as 1st day plus
200 gr.dehydrated fruit

V. Special Mountain Rations:

Composition A

Composition B

No more manufactured and existing supplies are used up

VI. Additional Rations for Infantry Combat Troops:

Stimulating	Quickly active:	Slowly active:
5o gr.coffinos (Hikola,cola bon-bon,moccha candy,moccha-bon-bon) or	5o gr.dextrose (Dextro-Energen) or	8o gr.fruit concentrates (fruit slices or fruit bars) or
5o gr.milk-moccha-glycolade or	5o gr.tartaric acid sugar or	8o gr.wheat drops.
5o gr.choca-cola	5o gr.nutritive bars	

8o gr.nutritive cakes (Kraftkeks)
6 cigarettes.

The Iron Ration: used only in case of emergency or when commanded. A man carried it with him when he left his base or headquarters:

250 grams rusk or Knäckebrot
2oo grams canned meat.

When it was possible to transport the Iron Ration by vehicle the following ingredients were included:

25o grams rusk or Knäckebrot
2oo " canned meat
15o " Wehrmacht dried soup
2o " roasted coffee.

Emergency Ration: to be dropped by parachute to isolated or trapped groups of men:

3oo grams Emergency Ration meat or
3oo " " " sweet

and

3oo " Dauerbrot or fresh bread.

The above amounts of food could be increased if there was sufficient space available in the transport plane.

3oo grams Emergency Ration contained 13o o to 16oo calories.

Wounded or sick soldiers and blood donors were also given special rations (composition not known).

Reaction of Troops to Different Foods:

Unsatisfactory Foods and Reason for Dissatisfaction:

Every soldier brings with him the food habits and tastes of his home and country. In the Army he had to eat what was set before

him and when it was set before him. It was impossible to satisfy his individual food preferences and he soon became tired of Army food. This situation naturally made him a sharp critic of all Army rations. By his criticisms he wished to indicate to his associates that he was used to eating better foods at home. This characteristic is a weakness of the German people. The satisfaction of the troops was further complicated by the fact that there are different food habits in different sections of Germany. On a basis of food habits and tastes Germany can be divided into more than ten different geographical areas. In the minds of all soldiers foods were listed as good or bad depending upon his previous customs and his likes and dislikes.

slixed Food	Reason for Dislike
äckebrot	This is thicker than the usual form of Knäckebrot. However it cannot be packed and shipped in its usual form as it is too easily broken. Even in its thick form it was often broken because of a lack of adequate packaging materials. This product was hard to bite, particularly by older people with defective teeth. When it became damp it was tough in texture.
uerbrot	It did not taste as good as fresh bread. It had no crust. On long storage it became dry and cracked. Because of its low moisture content a portion of it seemed smaller than a portion of fresh bread. Thus the soldier was more interested in receiving fresh bread.
ergency Ration Meat:	This meat was served as an emergency ration or under other conditions when it was old. When eaten under emergency conditions it was monotonous and unpalatable because of its high fat content. Hardened sunflower seed oil was usually used as the source of fat. It had a soapy and dough-like taste when eaten uncooked. It was not stable during storage and after a short time it developed a soapy and musty taste. Often it contained oats which gave it a bad taste.
nned Beef	Because of the high processing temperature (120°) it often had a gluey taste. It was usually too dry to spread on dark bread, although it was not originally intended for this purpose. When cooked up in a stew it broke up and the soldier could not find his meat ration.

Lentils	Often they were stored too long and were hard. Sometimes old hard lentils were supplied which could not be cooked to make a soft product. Germany did not produce many lentils and much of them had to be imported from the Balkans. The supplier frequently shipped very low grade lentils.
Millet Grain	An unusual food in Germany. Often had a slight phenol flavor, this could be removed by a short steam blanching, Small kernels did not give consistency to foods.
Groats	Had a bad name for World War I when they were called "calves teeth" or "blue Henry". The roots also had a bad name from the last war when they and the groats were the chief food of all Germans. The winter of 1917 was known as the "root winter". The soldiers were definitly prejudiced against them.
Dehydrated Vegetables	Considerable variation according to manufacturer, storage time and conditions. Many had poor color and flavor. Sometimes were hard and difficult to reconstitute. Not as good as fresh vegetables. Difficulty might have been due in part to many of the emergency dehydrators that were set up.
Cheese Powder (many different opinions, some favorable and some unfavorable)	It is possible that product had bad consistency at times because it was not stirred sufficiently when it was reconstituted, with the result that it contained lumps. The cheese powder often had a "Limburger"-like flavor.
Artificial Honey (divided opinions as to quality)	Sometimes had a red color and too strong an aromatic odor. Because of its higher caloric value smaller portions were served than marmalade and so soldiers felt they were not getting as much.
German Tea	Lost its flavor during long storage. Often the packaging material was not good. Sometimes poor blends of tea were used.
Apple Powder	Sometimes had a fishy flavor which was attributed to oxidation.
Egg Powder	Often had biscuit-like flavor due to too high drying temperatures.
Marching Beverage	Often had terpeney flavor.
Bratlingspulver	At first it was sometimes indigestible and often not correctly used.

Methods Whereby Disliked Foods Might have been Improved:

Food Material	Method
Knäckebrot	Bake in thinner loaves
Dauerbrot	If possible store only for short periods of time.
Emergency Meat	Reduce caloric value and make more digestible by using less fat. Do not use bitter oats as an ingredient. By addition of crumbs of Knäckebrot or rusk was more acceptable and not so soapy and raw. Use a more digestible fat than sunflower seed oil (not actually tested). It was not used after late 1944. After that time front lines were so close there was no need for special emergency ration to be carried long distances by plane.
Canned Beef	By frying the beef before filling into cans. This process was difficult to adopt in many factories with large production due to the lack of equipment and labor.
Lentils	Lentils and other old and hard legumes should be sent to plants where they could be ground up and used in soups.
Millet Grain	Proper cooking directions should have been supplied to all Army kitchens.
Groats	Should be ground to smaller particle size and used as base for bratlingspulver.
Dehydrated Vegetables	Steps should be taken to maintain good quality.
Cheese Powder	Should follow recommended recipes in using product. Variations could be made by addition of spices, herbs, onions, and bratlingspulver.
Artificial Honey	Color and flavor and keeping quality should be improved.
German Tea	Better blends could be developed.
Apple Powder	Should use only fresh pectin.
Egg Powder	Should use lower dehydrated temperature.
Marching Beverage	No attempt made to improve it as citric acid and adequate packaging materials not available.
Bratlingspulver	The ingredients were changed but they did not improve it too much as materials of high food value which could not be used otherwise had to be included. New recipes were developed for its use.

Acceptable and Well-liked Foods

Food Material	Reason for Acceptability
Schokakola Schokolade Dextro-Energen Fruchtschnitten Cookies Fruit bars Drops Emergency Ration Sweets	The soldier likes to eat sweets. B- can carry them in his pocket and eat them whenever he desires.
Fresh bread Cured meat Cured sausage Smoked bacon	Heavy foods to which men had been accustomed at home and with high taste value. The fact that they were not commonly available increased their acceptibility.
Canned pork Oil sardines	Were liked because they added fat to the dried bread.
Eggs	Soldier could cook them himself and they added variety to his diet.
Peas	An all around well liked food.
Canned vegetables Fresh vegetables Fresh potatoes Pudding Condens milk Butter	Well liked in their usual form.
Coffee Cocao Black tea Wine Schnaps Beer	All are items that soldiers had not had for a long time. Rare luxuries in Germany.

New Food Products Developed and Considered During the War but Not Given Final Acceptance by OKH.

Special Products and Formulae:

In the following outline food products are listed which were being developed and which showed promise of being successful. Also included are products which were fully

developed and satisfactory but were not adopted by the Army for various reasons such as: shortage of raw materials, lack of new equipment and machines, lack of packing materials etc.

Foods indicated thus (x) were not completely developed at the end of the war.

x) 1. Concentrated mixed conserves in cans
2. Dehydrated mixed conserves.
x) 3. Spiced meat, smoked or unsmoked and dehydrated.
4. Canned meats with added vitamins for the tropics.
5. Canned meat without added cooking salt for use by Navy.
6. Fried meat to spread on bread and for use as a sauce.
7. Canned whale meat.
8. Smoked meat baked in bread dough.
9. Sausage stretched with added soya flour or bratlingspulver.
10. Smoked bones.
11. Synthetic fat.
x) 12. Butter powder.
x) 13. Oil powder.
14. Potato chips with fat removed.
15. Potato dumpling flour.
16. Partially cooked potato soup and rice soup.
17. Vegetable noodles as spinach noodles and tomato noodles.
18. Flaedle (Dehydrated pancake strips)
19. Pancake powder.
x) 20. Pancake paste.
21. Cold pudding.
22. Muesli (made of oats, sugar, milk powder) prepared cereal.
23. Nugat mass from roasted cereals.
24. Vitamin marzipan.
25. Marzipan-like products from pine nuts and plum seed kernels.
26. Dehydrated fruit slabs.
27. Marmalade powder, apple powder.
28. Sanddornberry juice.
29. Schokotropa or Tropolade (tropical chocolate)
30. Chocolate stretched by knäcke bread, soya, and peas.
31. Cocao beverages with barley flour or pumpkin flour.
32. Compressed herbs.
33. Herbs highly compressed into a cone form to be grated.
34. Yeast flakes.
35. Yeast paste with onions.
x) 36. Dry vinegar.
37. Self-heating cans.

Description and Purpose of New Products:

1. Concentrated mixed conserves.

Purpose: to conserve packaging materials and shipping space.

Use: Contents of can mixed with equal volume of water or liquid for use.

Made by concentration of liquid of normal canned foods to one half volume.

2. Dehydrated mixed conserves.

Purpose: To conserve packaging materials and shipping weight.

Pressed out of dehydrated meat, cereals and spices.

Use: Break up and cook in boiling water 40-60 minutes.

3. Spiced meat-dehydrated.

Purpose: To conserve metal ans shipping space.

Use: Soak two hours in water and then boil two hours.

Dried without fat and sometimes smoked. Ground, before drying to various size pieces. Poor consistency. Herbs may be added to make a spiced meat which may be used in goulash. Flavor good.

4. Canned meat with added vitamins.

Purpose: for use in tropics and as source of vitamins.

Use: May be eaten cold or warm. When eaten warm can be heated in water bath.

Made out of lean meat mixed with pork. Gelatine from pork skin added to make a consistency that could be sliced. Lightly spiced and added yeast paste and tomato powder or paste.

5. Canned meat without added salt.

Purpose: For Navy when sea water added in cooking.

Use: Can be used cold or warm. Salt can be added if conditions justify.

Meat canned with added spicing to give desired flavor. When salt water (sea water) must be used in cooking its use would ordinarily add too salt to the diet. This product because of its low salt content can be used effectively under such conditions.

6. Fried meat paste.

Purpose: To preserve meat and save packaging materials

Use: Cold to spread on bread. Warmed with water and flour to make goulash with meat pieces.

Made of pork, veal, lard, onions, pork skin, tomato paste and spices. Strongly fried to develop good flavor. Fried meat pieces then cooked up in sauce and water evaporated to a paste consistency. Product packed in cartons and could be stored 3-5 weeks at room temperature. Good keeping qualities

if moisture content below 25%. If canned, there is a saving of 5o-6o% of metal.

7. Canned whale meat.

Purpose: To utilize a source of protein that did not require German feed-stuffs for its production.

Use: As goulash with water, onions and flour added.

Very lean whale meat used. Tasted similar to strong ox meat, and looked like ox meat. Meat has coarse structure. Only whale meat canned on board whaling vessel immediately after being caught had a flavor. It was very important that meat be canned immediately as a fishy flavor developed upon a very short exposure to air and light.

8. Smoked meat baked in bread.

Purpose: The emergency ration meat was not too satisfactory and this was a method of finding a better product.

Use: Eaten cold.

A tasty and agreeable heavy food which was covered with rye or mixed flour dough and baked. Its keeping quality was the same as bread itself.

9. Stretched sausage.

Purpose: To stretch or extend meat.

Use: Eaten cold.

Full fat soya flour (5-1o%), or ground wet mixed sprouted grains (2o-25%), or bratlingspulver mass (25%) mixed with sausage meat. Used to stretch fresh and canned sausage. By this means the portions of sausage appeared larger and also contained more calories.

1o. Smoked bones.

Purpose: The goal was to have more varieties and better tasting foods, and also to improve the keeping quality of bones.

Use: Bones soaked in cold water and then cooked or cooked directly in the food which they were to flavor.

Bones have strong smoked taste which adds to flavor of dishes in which they are used especially when there is little meat.

11. Synthetic fat.

Purpose: To overcome the shortage of fats.

Use: As a bread spread when in emulsified form. For cooking fat if not emulsified.

Made from coal-byproducts at factory in Witten. Fat emulsified and vitamins and butter flavor added to produce product similar to butter Mixed with lard an agreeable fat was produced. OKH staff members used this fat in their diet for a long time in order to show that it had no ill effects.

12. Butter powder and
13. Oil powder.

Purpose: To raise the melting point and to improve keeping qualities of butter and oil.

Use: To spread on bread-stir softly with cold water. For cooking add powder directly to product. These products seemed to have good possibilities for use in prepared foods.

The fat of the powder had a melting point of 70°C. The butterpowder color was yellow white and the oil powder pure white in color. When butterpowder was mixed with water a bread spread was produced but it had lower viscosity than butter. It had a sweet cream taste rather than a butter taste. Made by producing an emulsion of heavy cream and starch in which the fat was absorbed on starch. It was then spray dried by Krause system. Good for cooking, except frying in which case the starch and protein separated out and burned on pan. Oil powder was good in mayonnaise or salads. When lightly pressed had same volume as butter. Nutritive value of powder about equal to that of fresh butter.

14. Potato chips with fat removed.

Purpose: To provide a food that could be eaten out of the pocket and which did not break.

Use: Eat cold out of pocket.

Made like potato chips and then most of fat removed by a special method (method not known).

15. Potato dumpling flour.

Purpose: To maintain a fresh potato flour during shipping in cold weather as fresh potatoes become sweet.

Use: Mix with cold water, form into dumplings, put in boiling salt water, cook and add fat.

Makes it possible to make potato dumplings without any other ingredient but water. Baked potato flour was in grit form. Potato flour sometimes blended with egg substitutes.

16. Partially cooked soups:

Purpose: To add variety, to save time, to make it easy for one person to feed a large number of troops.

Use: Place in hot water and cook 2o-4o minutes.

Made of partially cooked dehydrated potato squares or strips with dry bacon squares and spices; or from technically prepared rice mixed with dried plums and other teasty ingredients.

17. Vegetable noodles, spinach noodles or tomato noodles.

Purpose: To add vitamins and variety to meals.

Made by addition of vegetable juices to the noodle dough. Juices concentrated by freezing were usually used.

Use: Like ordinary noodles.

18. Flaedle (Dried pancake strips)

Purpose: A high food value material which could be prepared rapidly. Easy to carry and therefore good for mountain troops. Had high nutritive value and low weight.

Pancakes sliced in strips and dehydrated. Can be manufactured very rapidly.

Use: Pour hot broth, water or milk over them, or place in hot liquid.

19. Pancake powder
2o. Pancake paste.

Purpose: Concentrated, readily prepared food for mountain troops.

Made of flour, whole egg powder, whole milk powder, butter, sugar, flavoring and might be fried in their own fat.

Use: Mix with water and fry in own fat on pans.

21. Cold pudding.

Purpose: For a readily prepared pudding without the use of heat.

Consisted of prepared starch, milk protein, sugar and flavoring.

Use: Stir with required amount of water and let stand 4o minutes to set.

22. Muesli (prepared cereal)

Purpose: Planned as an agreeable and readily prepared food for flyers before taking off on mission.

Composed of whole egg powder, butter powder, milk powder, prepared oats, sugar, salt and fresh lemon peel.

Use: May be eaten in dry state or mixed with water and allowed to set. Was best when mixed with water or milk for a few minutes and eaten as sweet soup either cold or warm or as cold pudding.

23. Nugat-like mass from roasted wheat.

Purpose: To replace the nuts in filling for chocolates.

Use: Eaten cold as a sweet food bar.

This was a tasty material made from finely roasted wheat, hardened fat, sugar and flavoring. At first the wheat was roasted in hot sand in order to insure uniform heating without burning.

24. Vitamin Marzipan.

Purpose: To supply vitamins in a food of high caloric value.

Use: To eat in original form or as filling for candies.

Marzipan mixed with orange peel, orange pulp, rose hip pulp or apricot pulp. When it contained enough sugar with a low moisture content it had good keeping qualities.

25. Marzipan-like product from pine nuts and plum seed kernels.

Purpose: A replacement for almonds which were difficult to obtain.

Use: Eaten as food bar or as filling for candies.

Could be eaten as a food bar. The pine nut has a remarkably good flavor but because of its oil content does not remain fresh too long. The flavor is more staple if the pine nuts are roasted.

26. Dried fruit slabs.

Purpose: To conserve fruits.

Use: Eaten in original form or in the preparation of marmalade or compotes, by cooking with required amount of water.

Made of apples or apricots or plums or tomatoes by drying concentrated pulp on roller dryers. Fruit was dried in film 2-3 mm. thick. Pect sometimes added to fruit such as apricots or over-ripe plums.

27. Marmalade powder or apple powder.

Purpose: To conserve packaging materials and shipping space.

Use: Mixed with water and citric acid or lemon juice and stirred 1-2 minutes. Allowed to stand 45 minutes to jell.

Fruit pulp dehydrated by spray drying method. Pectin sometimes added.

28. Sanddornberry juice.

Purpose: To provide a fresh beverage containing vitamins.

Use: Drink with or without added water.

The juice of the sanddornberry is sweet astringent, and rich in vitamin C.

29. Schokatropa or Tropolade.

Purpose: To supply a chocolate that would not melt too fast under tropical conditions.

Use: To eat as chocolate in tropics.

Contained cocao butter, in only small amounts but due to good finishing and graining it had a good consistency. The addition of orange peels improved its flavor.

3o. Stretched or extended chocolate.

Purpose: To conserve raw cocao.

Use: As usual.

a) The addition of a small amount of knäckebrot to chocolate provides an agreeable food. It has a "krokant" character and is easily digested because of the bread in it.
b) When full fat soya flour is blended with chocolate a product of smooth consistency is produced. Persons with a sensitive taste may notice a slight legume-like flavor.
c) When extended with roasted pea flour chocolate does not loose its taste value.

31. Cocao beverages.

Purpose: To save raw cocao.

Use: As cocao in usual manner with or without added milk.

Made by mixing roasting barley flour or pumpkin flour with cocao. The product has a good body.

32. Pressed dehydrated herbs.

Purpose: To add taste variety and to save space and packages and to conserve aromatic oils.

Use: Add to food to be flavored and cook 2o minutes.

Blended herbs like dill, tumeric, or majoram are compressed.

33. Dehydrated herbs pressed into cones.

Purpose: To save space and to better conserve aromatic oils in herbs.

Use: A short time before the dish to be flavored is completely cooked the dried herbs are grated into it.

Dried herbs compressed under high pressure into cone-shaped forms.

34. Yeast flakes.

Purpose: Source of protein and vitamins.

Use: Place in boiling water and cook for only a moment.

When of good quality this product provides a rich taste, somewhat resembling chicken soup.

35. Yeast paste.

Purpose: To add color, flavor and vitamins to foods.

Use: Stir with hot water and add to dish.

Made of yeast and onion paste. Onion residue from concentrated onion juice plants used (added)to improve the flavor.

36. Dry vinegar.

Purpose: To save package space and weight.

Use: Dissolve in water and use as ordinary vinegar.

Made in cubes or squares similar to sugar. Only a simple package required. This product had a slight sweet taste as well as being acid. This was helpful because in many cases when a food is acidified a little sugar is also added to improve the flavor.

37. Self-heating cans.

Purpose: To warm up canned foods without use of fireplace.

Use: When can was to be heated the cover of the compartment holding the quicklime and water was punctured in a manner so as to mix these two materials and thus produce heat.

The sterilized can has a separate compartment on the end which contains quick lime and water. These two materials were separated until the can was punctured.

Field Cook Books and Related Publications.

The Army Field Cook Books were prepared by the Chief Dietitian of the OKH. In addition to the cook books themselves special supplements were prepared and sent out from time to time to cover specific foods or situations. The cook books were made in loose leaf form so that supplementary pages could be added from time to time. Other publications dealing with Army cooking and subsistence were also available. A partial list of such literature follows:

1. Field Cook Book (Appendix I, Item 62)
2. Field Cook Book for Warm Climates. (Appendix I, Item 63).
3. Field Cook Book for the Caucasus (Appendix I, Item 64).
4. Supplements to Field Cook Book (Appendix I, Item 65).
5. Foods Made with Soya. (Appendix I, Item 66).
6. Merkblatt-Instruction circular on prevention of food spoilage (Appendix I, Item 67).
7. Merkblatt for the field cook (Appendix I, Item 68).
8. Merkblatt-information on vitamins. (Appendix, Item 69

9. Merkblatt- potatoes as food for Army. (Appendix I, Item 7o).
1o. Merkblatt- quick frozen fish and use of full fat soya flour. (Appendix I, Item 71).
11. Merkblatt- use of yeast. (Appendix I, Item 72).
12. Merkblatt- renovation of field kitchen equipment after poison gas attacks. (Appendix I, Item 73).
13. Instructions for administrations of Army kitchens. (Appendix I, Item 74).
14. Experiences in feeding troops during African campaign. (Appendix,I, Item 75).
15. Report on instruction of front line field cooks (Appendix I, Item 76).
16. Copy of "Mitteilungsblatt for den Feldkoch". (Appendix I, Item 77).
17. Copy of "Gemeinschaftsverpflegung". (Appendix I, Item 78).

Summary and Comments on German Army Subsistence.

Good Points:
Organization:

By means of procurement laws and regulations the quality, kinds, and amounts of foodstuffs required were assured. Speisenplanes issued every month made it possible for OKH to direct the use of potatoes and vegetables in the Army rations and to make sure that foods were used to best advantage, in so far as possible. (see Appendix I, Items 79, 8o, 81 and 82).

Facilities to help and advise the OKH in improving Army Rations were as follows:

1. The Committee on Food for the Wehrmacht (concerned with economic and scientific matters). (Appendix I, Items 83, 84, 85)
2. Food and food packaging experts from industry and research institutions served as consultants to OKH.
3. The Institute for Cooking at Frankfurt, and the Institute for the Preservation of Foods at Munich carried on research on pertinent problems and advised the OKH.

Instruction kitchens for the training of food officers were maintained. Two Army cooking and food science schools served to train 1o.ooo officers and seven Wehrkreis instruction kitchens trained 15.ooo field cooks. Cooking and baking teachers for the front lines were also trained in these schools.

Field cooking personnel were given an opportunity for advancement in the Army as

an incentive for them to do good work. (Appendix I, Item 86).

Technical Developments included railway kitchens and kitchen ships. A "cooling chain" was organized for the storage and transportation of frozen foods for the Army. (see Appendix I, Item 87). Educational exhibits, moving picture films and slides were used to train personnel in the subject of foods.

Research and Development.

Continuous research work was carried on in order to find, develop, and utilize new food materials. Fields of investigation included:

(1) use of plant proteins to supplement the available meat supply, such as bratlingspulver, yeast protein from sulfite liquor,
(2) use of sprouted corn, soya, and rye grains to stretch sausage (Appendix I, Item 88).
(3) utilization of protein from soya, rape seed, lupine, and sunflower seed,
(4) utilization of casein and blood as sources of protein,
(5) development of new bread spreads such as fish paste, marmalade from apple pulp, sugar beet pulp and sunflower-seed pectins, use of green tomatoes and pumpkin to extent marmalade,
(6) increased production of herbs,
(7) utilization of sugar beet leaves,
(8) increased production of dried vegetables and potato powder,
(9) fortification of foods natural and synthetic vitamins (Appendix I, Item 89, 9o).
(1o) synthesis of fats from coal and production of sugar from wood,
(11) stretching raw cocao with cereals etc.
(12) development of special foods containing stimulants and quick sources of energy (such as grape sugar),
(13) development of foods which could be used in tropics,
(14) consideration of climate and adaption in composition of rations. (Appendix I, Item 91).

Efforts were made to conserve shipping and storage and packaging materials by means of: dehydration, freezing, compressing, concentrating, use of filling with agitation to settle light powdery products, development of flame peeling methods of potatoes in order to save raw material, development of packages which would conserve metal and other critical ra-

terials, standardization of shipping cartons and cases. (Appendix I, Item 92).

Field cook books, for all theaters of operation, when necessary, were prepared, formulae for the utilization of new raw materials were prepared and distributed, and Merkblätter on the precautions to be taken in the preparation and cooking of foods to prevent waste were supplied to field cooks. A newspaper containing hints and advice to Army cooks was an important medium of new material, and cooking lessons. (Appendix I, Item 94).

Field Foods and Supplies.

Field bakeries, butcheries and kitchens always accomplished the combat troops and thus assured them of a supply of fresh meat, bread and warm food.

The field kitchens had one double wall glycerine bath kettle for cooking soups and other foods. This made it possible to serve one or two hot meals a day and also provided a means of keeping the food warm, without burning it, at all times. These kitchens were mounted on wagons or trucks during long marches so as to provide warm food while the troops were on the march without the need of building a special fire to cook the food. These pots could be used either as an open kettle or as pressure cookers. In order to cook two or three kinds of food separately at one time these pots were equipped with wall or dividers. In addition to the glycerine bath kettle the field kitchen also had a single wall open pot for cooking coffee and other beverages. It could also be used for cooking other foods. In order to increase variety and flavor of foods the field kitchens were also equipped with facilities for frying. The field kitchens were only used when other facilities for cooking were not available (Appendix I, Item 98).

Small stoves heated by a solid spiritous material, which could be used for heating one can could be carried in the pocket were available for individual soldiers. Small stoves were also used for heating trucks and wagons during cold weather to keep foods from freezing during shipment.

Supplies of food for ten days which could be delivered three times a month by airplane to groups of troops were also prepared and used (Appendix I, Item 95, 96). Supplies of these ten day food units sufficient to feed 500.000 people for 30 days were maintained in each of four EVM warehouses. These units were packed in chests equipped with parachutes. (see Appendix I, Item 97). Light weight, space saving and readily prepared foods were selected for this purpose.

EVM Warehouses:

The EVM warehouses were decentralized and spread around over the country in order to guard against bomb damage. In the warehouses every effort was made to guard against food spoilage. Provision was made for the return and re use of packages where practical.

Bad points.

Organization.

The OKH was a large organization with the result that there was much overlapping of duties and responsibilities. Like many other large organizations a continuous "paper war" was carried out. A shifting of the blame when mistakes were made was also a common practice. Because OKH was so large all matters and decisions had to go through channels which were time consuming. This situation was particularly bad after OKH had to be divided and moved into different buildings and cities as a result of bomb damage, and resulting communication and transportation difficulties.

Food Portions.

The way the German Army Ration was based on food portions presented a problem, particularly in the case of vegetable portions. The portions of different vegetables varied considerably in nutritive value - e.g. the use of 50 grams dehydrated sauerkraut in place of 1500 grams of potatoes would make a drastic difference in the nutritive value of the meal. This situation could have been improved by dividing the vegetables into groups, on a basis of caloric content. However, shortages of some products made this impossible.

Sometimes foods were held in storage too long or inferior foods were supplied by sources outside of Germany, which could not be controlled. A shortage of metals made it impossible to equip all field kitchens with frying facilities. Thus if a cook lacked imagination a monotonous diet of stews might result.

SECTION IX.

SOME GERMAN WARTIME FOOD RESEARCH ACTIVITIES.

Reported by

W.F. Straub
G.T. Carlin
W.B. Esselen
R.W. Pilcher

Some German Wartime Food Research Activities.

In the course of this survey, contacts were had with a number of agencies, institutions, laboratories or individuals who had been in contact with certain phases of food research in Germany during the war. The information received during contacts of this type may possibly prove of interest to some and has consequently been summarized in this section.

The Institute For Food Technology, Munich.

The key of this Institute für Lebensmittelforschung was as follows:

Dr. Rudolf Heiss, Director and Chief, Technological Section
Dr. Friedrich Kiermeier, Chief, Chemical Section
Dr. G. Kaess, Chief, Physical and Microbiological Section.

Origin!

This institute was founded in 1941 prior to the entrance of the United States into the war. The agency was finacned by German food industry , and the founding genius was Dr. Rudolf Heiss, the present Director. It would appear that Dr. Heiss differed with the policies and research interests of Dr. Planck, Director of the Kälte Technischen Instituts at Karlsruhe, where Dr. Heiss had been a staff member. Consequently, Dr. Heiss left to form the Institutes für Lebensmittelforschung taking with him his closest collaborators Dr. Kiermeier and Kaess. A complete statement on the purposes and objectives of the Institute , together with a list of the sponsoring organisations appears as appendix XXV of this report. The Institute prefers to be called the Institute For Food Technology, rather than by the literal translation of its name, food investigation.

Organization.

The Institute is divided into three main-sections; the Technological Section headed by Dr. Kiermeier, and the Physical and Microbiological Section supervised by Dr. Kaess. This division is for purely administrative purpose since the work of the three sections is frquently closely interlocked. The staff

was reported to have comprised a total of 45 persons when at its maximum personnel strength during the war, of whom 8 or 9 ware highly trained scientists.

Equipment and Facilities.

The Institute is housed in a series of rambling wooden buildings located in a somewhat dense of trees, presumably for camouflage purposes. The original buildings were largely destroyed in an air raid in 1943 and the present buildings erected. The fact that the Laboratories were restored is a suggestion of the importance which was attached to the work of the Institute.

The equipment of the Chemical and Physical and Microbiological Sections was much, the same as is to be found in similarly equipped laboratories in the United States. As is usual, numerous special purposes instruments or devices were to be found which had been built in connection with certain of the investigations undertaken. The Technological Laboratory, however, was especially well equipped with laboratory model dehydrators, including one Imperial type and a spry drier received too late in the war for installation; cold and freezing rooms maintained at a variety of temperatures, experimental freezing and dehydrating equipment; hand can closing machine; and special testing devices for work on fibre cartons or fibre packaging material.

Scope of Activities.

Considering the age of the Institute (4 years) and the size of the staff this agency has made a remarkable a record as far as technilogical contributions are concerned. The staff is credited with a relationely large number of publications in the German literature covering a variety of technilogical subjects. This number is surprising since the Institute did not actually begin experimental work until the Autumn of 1942. As Appendix XXVII is attached a complete statement on the past current activities of the Institute complied by Dr. Heiss. The major research activity be decribed may be summarized as follows:

1. Quality improvement in dehydrated and frozen foods.
2. Lime water refrigerated storage of eggs.
3. Improvement of preserved bread (Dauerbrot)
4. transportation of butter in hot weather.
5. Keeping quality of sausage.

6. Saving of transportation space.
7. Conservation of raw materials (substitutes for metal).
8. Comparative requirements of commercial dehydrators.
9. "Combat against starvation" - development of new foods in the current food shortage in Germany and the limination of waste.

Certain of these items (Dauerbrot and the comparative study on dehydrators)were of sufficient interest to warrant inclusion and more complete discussion in other sections of this report (sections VI and III). Some comment might be made on some of the other items listed.

Quality of Dehydrated Vegetables.

As Appendix IX is attached recent (11 July 45) instructions issued by the Institute for the guidance of manufacturers in the production of high quality dehydrated vegetables. These brief instructions incorporate the ideas of the Institute staff as a result of work on enzyme systems present in common vegetables, vitamin estimations and organolepetic tests an packaged and stroed dehydrated foods.

As indicated section III on dehydrated foods, from these instructionsit is not clear just why any dehydrated foods made in the above recommended manner should be any higher than if prepared tocommon American techniques. Apart from the consistent use of boiling water blanchs (100°C) the recommended practices suggest nothing new. Samples of these dehydrated products with dry and reconsistitutes have been examined and do not support the claim of high quality made by the Institute or the manufacturers. Perhaps some of this difference of opinion as to quality may be explained on the basis that the quality of the cooked raw German vegetables is quite frequently itself not high. Therefore, a smaller quality difference may exist between German cooked and dehydrated vegetables which serves to influence German opinion.

Dehydrated Meats.

During the course of the war the Institute had occasion to become concerned with dehydrated meat. A statement as to the variables studied and a summary of the work by Dr. Heiss appears as Appendix
Apparently the Institute did not thin k highly of the type of the product obtained

by dehydration; this is similar to experience gained on this same subject in the United States. As a preferred alternate to complete dehydration, it is recommended that the meat be dried to a moisture content of 20 to 25 % at 45°C and subsequantly canned in metal containers.

Lime Water Refrigerates Storage of Eggs.

The Institute has worked on the problem of extending the quality life or refrigerated eggs from a number of approaches, gas (CO_2) holding; dipping in cold mineral oil or hot mineral plus a bactericide; and dipping in hot water before refrigeration in a concentrated lime solution. The work on the latter method which Dr. Heiss prefers as most practical has not been published.

Fat Stability During Hot Weather Transportation

This work was undertaken in an attempt to improve the stability of butter and margarine-butter Wehrmacht spread mixtures. The experimental approach was through both packaging and formulation as well as by experiments on the effects of enzyme on fat emulsions. Changes in formulation so as to give a product which would spread at high room temperatures (35°C) appears to have been the result. As to the investigation on the effects of catalases, Dr. Kiermeier's findings are unlikely to be of material assistence to producers of fat emulsions such as mayonnaise,

Conservation of Packaging Materials.

A considerable amount of work was carried in this field, primarily in connection with the replacement of metal containers with paper or fib re substitutes. This work dealing premiously with the characteristics of paper, plastic and metal lomination, etc. for frozen packages has been systematically done. Since the results will be of interest to many fibre containers specialists, a translation of the major artical on this subject by Dr. Kaess appeats as Appendix of this report.

Institute Publications.

Besides the literature appended, the Institute or its staff h--e published several monographs
...ods.

Lime water
Improveme
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Keepi

which have become somewhat rare. These are:

1. Progress in Food Research, Investigonal Notes on Preservation of Food Freshness.

   R. Heiss. Theodor Steinkopp, Dresden und Leipzig, 1942. 209 Pages

2. Contributions to Supply Techniques for Foods.

   F. Kiermeier, R. Heiss, and G. Kaess, Theodor Steinkopff, Dresden und Leipzig, 1944 165 pages.

3. The Science of Storage and Perishable Foods.

   Milch und Lichtenfeld, Berlin 1941
   The only copy obtainable of this book was a galley proof which contains about 100-110 pages.

This material has been recorded on microfilm for future reference (Appendix I, Item 99) Inspection of the contents of these monographs led to the suggestion that they might best be assigned by the Office of the Quartermaster General to the QMC Subsistence Laboratory for library purposes. A list of other publications of the Institute appears in Appendix XXVII

Kältetechnisches Institute der Technischen Hochschule, Karlsruhe.

Dr. Rudolph Plank, Director of this Institute was interviewed on the general subject of frozen foods, freezing processes and research activities of his Institute carried on during the war. Research of this institution has been rather extensive in the fields of fundamental studies on the thermodynamics of refrigeration; design of refrigeration and freezing equipment; and the effect of different freezing methods on the quality of frozen foods.

In Germany, there are definetely two schools of thought as to the influence of temperature and rate of freezing on the ultimate quality of frozen foods. Dr. Plank and his associates advocate rapid freezing at relatively low temperatures (such as -40 to -50°C) in order to achieve optimum quality in the frozen product. This viewpoint differs diametrically from that of Dr. Heiss of the Institute of Food Technology, Munich, and other groups interested

in frozen foods these parties believe that, within limits, a slower rate of freezing at higher temperatures (such as -15 to -25°C) is more satisfactory or superior.

Thirty-three reprints of work carried on at the above Institution during the war were obtained as shown in Appendix I Item 99. Reference to some of Dr. Plank's work is also made in the frozen foods section of this report, section II.

Chemistry Department: University of Tuebingen, Tuebingen.

Prof. Butanaudt and Dr. Lehram of this department were interviewed on amimo acid because of the interest in these compounds for food fortification in the United States.

However, it was found that the research activities at Tuebingen were centered largely on the separation of individual animo acids by chromatographic methods. While this work appeared to be unusually thorough both men stated that its practual value was in the field of medicine rather in normal nutrition.

Food Technological Division, University of Munich.

Prof. Bleyer, director and his associates Drs. Thaler and Lindner of this devision were interviewed. The following subjects were discussed and general information obtained:

1. The manufacture of chocolate in Germany and factors preventing "bloom" during storage. Here the importance of uniformly cool, dry storage conditions was emphasized as paramount. However, all agreed that the diminution of milk in any form increased the storage life. Milk gradually contributes an undesirable after taste even under good storage conditions. A second factor in bloom prevention is the lowering of the fat content of the chocolate. Repeated fine milling and the addition of 1 % to 2 % of Lecithin aids in holding the smooth milling taste which

a larger fat content ordinarily contributes. Dr. Thaler called attention to the new high speed chocolate mill developped at Copenhagen. A full report on the chocolate industry in Germany appears in Section VII of this Survey.

2. Fruit Juice Concentrates and Dehydrated Specialities.

Concentration of fruit juices by freezing was said to produce the highest quality to date. However the cost was considered high. More information on this subject appears in Section VII of this Survey.

A new Swedish vacuum dehydrating unit was mentioned by Prof. Bleyer who had interested its operation at Stockholm at the request of the German government. Swedish patents under the name Gentile are said to have been granted. Professor Bleyer claimed he tasted a dehydrated coffee-sugar-milk mixture which could not be distinguished from the freshly browed coffee which stood only 30 minutes while a portion was being dehydrated. He also stated that after a years storage the powder upon addition of hot water was most delicious. Other foods including meats. fish, etc. were dehydrated in most satisfactory fashion during this demonstration.

No further information is available and while the procedure may be too costly for large use, it is mentioned here to suggest study by those who might be interested.

3. German Army Food Research.

Dr. Lindner was formerly on the German High Command staff.He discussed army food problems particularly substitute foods as normal food materials become scarce. He suggested contacting Dr. Ziegelmeyer, Chief of all Army technological research at Berlin, and Fräulein Spiess his immediate assistant at Benedict-Beuren. This Fraulein was brought to Frankfurt by these investigators and her report including Dr. Ziegelmeyers additions to it appears in full under Section VIII. "German Army Rations" of this Survey.

Laboratories of Dr. Georg Krause, Pfaffenhofen.

Dr. Krause is an outstanding German consulting food chemist, who served some American food manufactures before the war. His laboratories at Hölriegelskreuth and at Munich were damaged by bombs.

However, he was located and supplied the information on the following subjects covered below or elsewhere in this report:
1. Potato dehydration and especially the spray dried potato meal containing milk and salt (Krause spay tower patents).
2. Sauerkraut Dehydration.
3. Fruit and vegetable juice Concentra - tion by Krause Continuous Freezing process.
4. New type of Baking Powder (as signed to Oetker Col).
5. Katadyn Method (Utilization of loligodynamic action of silver).

With reference to impressive German claims on the value of silver ions in food preservation Dr. Georg Krause stated that this action of silver has no value in achieving or maintaining a sterile condition in any processed fruit vegetable or other food. The beneficial action is limited entirely to purification of water, and the method was used widely by the German Army for that purpose. Dr. Krause also states that the aging of alcholic beverages is hastened materially by placing silver covered porelain spheres in the liquid. This statement checks with practical U.S. experience.

Staatliche Molkereischule, Weinststaphen (near Munich)

The Director, Dr. Zeiler and associates Drs. Fritz and Zeuss were interviewed, and the following subjects discussed:

1. Addition of aminobenzoic acid and traces of manganese salts to milk from silage fed cows. This is claimed to improve the quality of the cheese made from such milk. Drs. Demeter and Janochek who did this work were under confinement at Weinststaphen and were not contacted. German grading of cheese - 20 points being perfect - raised the quality 1 point a cheese made from milk treated with these chemicals as against the con-

trol batch made from the same milk untreated. Compared to the grading scale in the United States where 100 is perfect, this would mean an improvement of 5 points.

2. A new method of making swiss cheese using milk from silage fed cows developed by Dr. Hanusch at Weiler (near Lindua) after seven years work. This experimental process was praised highly by Dr. Zeiler.

3. The Fritz continuous process for butter production (reported in the section on fats and oils, section VI).

Shortly after this investigation, two dairy specialists joined the Intelligence Branch and the above items on cheese were referred to them. Their report will be made separately and the above subjects summarized here merely to direct the attention of those especially interested in this further report. Fifteen recent publications are included in Appendix I, item 101.

DEUTSCHE VERSUCHSANSTALT VON DER REICHSFÜHRUNG HERPENHEIM.

This was essentially an experimental dehydrating plant which maintained its own product acreage, It had been sponsored by the S.S. and consequently had every advantage in securing equipment and supplies. Two of the latest model Imperial dryers were used in experimental and larger runs with celery, parsley, chives, paprika, ariens, leek, carrots, peas, cabbage and a number of herbs and spices. The main objective was preservation of vitamins in dehydrated foods and studies on high vitamin content plants.

The gardens were operated as a youth project with large plots assigned to groups of school children. Gladialos were grown in quantity as a source of Vitamin C; other berries were collected and dried for the same purpose. Vitamin assays were made on samples sent to Berlin. Plant labor comprised several hundred displaced persons treated as forced workers. The typical concentration camp accomodations layer upon layer of wooden bunks which barely permitted an average sized man to lie down were evidence of this fact and perhaps will serve to explain why this unit failed to make a worthwhile contribution to the industry.

The former operating superintendant who was interviewed along with various towns-people, stated that the only satisfactory developments were in the herb and spice plant field. Low temperature drying 60°C was practiced to preserve flavour and vitamine. Several trial runs were made on potatoes without blanching or precorking but all turned blue and the project was closed. Samples of various flower, berry and herb dehydrations were located at a local warehouse. The quality was poor.

This establishment was an example of the finest type of dehydrating equipment seen anywhere in Germany including a most modern power unit, abrasive type vegetable peelers, paddle-wheel washers and Transfarent Four Belt Dehydrators. - Yet the S.S. "forcing policy" apparently nullified all these advantages.

Chemistry Department, University of Heidelberg, Heidelberg.

Professor Freidenberg of thus institution was interviewed relative to research in the chemical field which might pertain to foods. His major interest lies in cellulose chemistry and the discussion consequently centered on the conversion of cellulose to foods.

Yeast from waste sulfite paper mill liquors, and sugar and alcohol from wood by the Bergius and Scholler processes were reviewed. The Zellstoff Fabrik Waldhof was said to produce the finest yeast from the waste liquors remaining after hydrolysis of hardwoods. Holzhydrolyze A.G. at Rheinau (between Mannheim and Schwätzingen) was cited as the outstanding manufacturer of sugar from wood by the Bergius process. (hydrolysis with concentrated hydrochloric acid).

Scholler process plants are located at Tornesch near Hamburg and Hildesheim. This source of sugar, Prof. Freidenberg agreed, was only a war time emergency and probably would be discarded after the German beet sugar industry begins functioning normally again.

The yeast production, however, was considered important in augmenting the protain supply in Germany. Information on this subject collected by this mission will be included in a separate final report.

Landwirtschaftliche Anstalt, Heidelberg.

Dr. Meisner, Director of this agricultural station war interviewed. His major interest were the culture of tobacco and sugar beets. The discussion therefore was limited to means of improving both the sugar content of the beets and the yield of beets per acre. A meeting was arranged with Dr. Besenfelder, Director of the Süddeutsche Zucker A.G., Wakhausel. This company, under Dr. Besenfelder's direction, conducted extensive beet culture plots on its acreage as well as tests on the extraction of sugar from the beets. A separate paper on this subject was prepared by Dr. Besenfelder. This is described in Appendix I, Item 107.

KAISER WILHELM INSTITUTE, HEIDELBERG.

Prof. Dr. Richard Kuhn, Director of the Chemistry Department of this institute and an assistant Dr. Schuber, were interviewed. Research done during the war which might have a direct bearing on food production follows:

1) Structure and synthesis of certain lactone like compounds which promise effectiveness in retarding sprinting of potatoes etc. while in storage (see Appendix).

2) Napthoquinene derivatives as possible new mold inhibitors for food products.

3) The Triphenyltetrazoliumchloride color test for gemination value and seedling vigor.

4) Potato plants resistant to the Colorado Potato beetle.

These various subjects are reported in detail, each as a complete write up below.

Landwirtschaftliche Hochschule, Hohenheim.

Contract was made with Prof. Georg Laken of this Institution following Dr. Kuhn's suggestion. Prof. Laken had carried out extensive Triphenyl-Tetrazolium Chloride Tests and the five major grains. The following covers this interview:

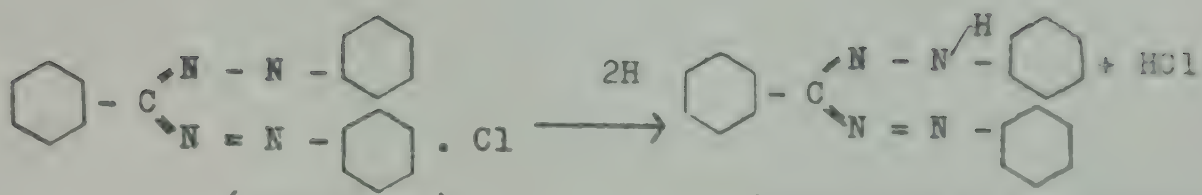
New Test For Seed Fertility.

One of the first attempts to improve upon the usual sprouting procedure for testing seeds was the use of selenic acid salts, a method which is generally known. These chemicals are toxic to seeds and a very conoxious and toxic compound, selenic acid (H_2Se) is formed during the test. These reasons and others stimulated a search for a less toxic and equally effective chemical reagent.

Dr. Richard Kuhn suggested the use of tetrazolium salts to Prof. Laken as Kuhn had noted the coloring effect on foliage when plants were fed a one percent solution of these compounds.

The tetrazolium test is based upon the fact that living cells in the seed embryo exert what is apparently a nearly quantitative reducing action which converts the colorless salt into a characteristic red colored

compound as follows: -



(colorless) (distinctive red color)

The living cells are colored red, therefore, while the dead cells remain colorless. The seed embryp structure is known to contain segments which <u>must</u> be alive in order to sprout into a growing plant at all, and furthermore the extensiveness of the red colored or living area determines the strength or value of the plant that will develop.

Dr. Lakon has made a large number of comparative germination tests using the routine sprouting procedure (which simulates growing condition of the plant) against the triazolium method on seeds from the same uniform sample.

By means of either magnified colored photographs of the red colored seed embryo or accurately scaled hand drawings under magnification, the direct relationship of colored embryo areas to actual performance of the same lot of seeds in soil was determined. Thus by marking a series of such control checked colored drawings either <u>positive</u> or <u>negative</u> any reasonably skilled technican may compare his findings in a 6 to 48 hour triazolium test and many accurately classify the germination value of unknown batches of seeds.

The answer to the question of germination or non-germination has apparently been thoroughly and successfully completed by Dr. Lakon for wheat, rye, barley, oats and corn. One of Germany's leading seed houses, Petkus Saatsuchwirtschaft has been selling its grain seeds on the basis of the triazolium test guarantee. This concern has run 5000 to 6000 tests on rye and over 2000 on oats per year since they started in 1942.

An important advantage enjoyed by the triazolium test against the conventional soil-sprouting procedure (in addition to reducing the time required from three to ten days to six to forty-eight hours) is its performance with freshly harvested seeds. Such seeds often do not germinate in a sprouting test if it is made soon after

harvest --- but after the seeds have been stored for some time they sprout normally. Here for practical purposes the sprouting method is not too reliable while the triazolium test made <u>early</u> will, it is stated, actually predict <u>the</u> germination results to be expected when the seeds are planted. This may be particularly important in planting certain crops, including winter wheat.

The expansion of this triazolium test to the point of predicting not only those seeds which will germinate, but also, those seeds which will produce strong food producing plants is being developed following the same technique of comparative checks against controls run by the sprouting method. Dr. Lakon has made enough progress to date to indicate the validity of this work, but requires more technical personnel and facilities to complete the work.

<u>Technique of test.</u>

For chemical germination tests on <u>wheat</u>, <u>rye</u>, and <u>barley</u>, the following procedure <u>is</u> used: -

Soak two groups of 1oo seeds each in water to soften them thoroughly so that the embryo may be easily removed. This requires from six to eighteen hours. Then remove the embryos with a lancet and allow them to stand 7-8 hours in a 1.o percent solution of tripenyl-tetrazolium chloride, in the dark and at room temperature. The embryos are then ready for examination and recording of results. Only those showing the distinctive red color throughout the germ nucleus area and at least partial ly in the root building portion are classified as positive.

The removal of the embryo by means of a surgeens lancet is stated to be relatively simple and 2oo embryos may be separated from their respective seed covering in 2o to 3o minutes by a practiced technician. It was said that this technique could be readily aquired by any person of reasonable intelligence. The color readings against control charts (Appendix I, Item 1o3) likewise involve no difficulty. It was further claimed that with a minimum of equipment even the small seed grower could easily learn to conduct this test effectively.

For chemical germination tests on <u>oats</u> no preliminary soaking of the seeds is

necessary, or it is necessary to remove the embryos from the seeds. The oat Kernels are covered with an aqueous solution containing 0.85 percent sodium chloride and 1.0 percent triphenyl-tetrazolium chloride. The seeds should be held in this solution, in the dark, for 24 hours. Color readings are made in the usual manner, as shown in Appendix I, Item 103.

For chemical germination tests on corn, the kernels are soaked in water at room temperature for several hours. The kernels are then out in half with a scalpel so that the embryo is exposed throughout its longest dimension. One hundred kernels are required for the test but only one section of each is used. The cut sections of the corn kernels are then just covered with a 1.0 percent triphenyltetrazolium chloride solution in a shallow dish and allowed to stand three to four hours in the dark. The examination and recording of the colored areas is then made and compared with a colored chart as shown in Appendix I, Item 103. In the case of the corn germ nucleus and secondary root source areas, at least half of the area should be colored if the seeds are to be considered good, as indicated in the above figure.

Additional Developments. (as related by Dr.Lakon)

Another further development in the use of this chemical test is the opportunity it offers for the study of susceptibility to disease in plants. A new conception of the action of certain plant parasites such as fusarium in rye, etc., is now possible. "Seedling vigor", as illustrated by the test, is of direct interest here. The beneficial effects of certain chemical nutrients, hormones etc. can be observed from the almost mathematical gauge of live cells in various generations of seeds, according to Dr.Lakon. The fact that triphenyltetrazolium chloride is not toxic to the seeds and permits planting and germination of tested seed in some cases, offers further research opportunities.

Dr.Lakon has conducted preliminary work on peas and beans. The results obtained to date indicate that this test is applicable to these seeds. It is necessary to study the seed of each particular plant as an individual project for that plant. The relationship of the extent of colored areas to the sprouting germination control tests must be determined. Likewise, the seed embryos of various plants must be studied and color tested to determine the important areas that must give a positive reaction to assure

germination and vigor in the growing plant.

Other Sources of Information.

1) Lakon, Georg 1940. Die topographische Selenmethode, ein neues Verfahren zur Feststellung der Keimfähigkeit der Getreidefrüchte ohne Keimversuch. Tire a part des Comtes-rendus de l'Association Internationale d'Essais de Demences. No. 1 Stockholm 19.

2) Lakon, Georg 1942. Topographischer Nachweis der Keimfähigkeit der Getreidefrüchte durch Tetrazoliumsalze. Sonderabdruck aus den Berichten der deutschen Botanischen Gesellschaft, Jahrgang 1942, Band LX, Heft 6/7. Ausgegeben am 19.Okt.pp.299-305.

3) Lakon, Georg 1942. Topographischer Nachweis der Keimfähigkeit von Mais durch Tetrazoliumsalze. Sonderabdruck aus den Berichten der Deutschen Botanischen Gesellschaft, Jahrgang 1942, Bd.LX, Heft 9. Ausgegeben am 30.Dec. pp. 434-444.

4) Kuhn, Richard and Dietrich Jerschel. 1941. Über Invertseifen, VII.Mitteil.: Tetrazoliumsalze. Sonderabdruck aus: Berichte der Deutschen Chemischen Gesellschaft, Jahrg.74.1941. Heft 6, pp. 941-948.

5) F.von Loche- Petkus, Berlin NW 87, Brückenallee 4. Large European seed house who have used the tetrazolium seed germination test since 1942 for wheat, barley, rye, oats and corn.

Institute for the Sugar Industry, Berlin.

The German sugar industry financed this Institute, and a close relationship between manufacturers, distributors was achieved. A cooperative arrangement with the University of Berlin on basic research also was found to be very effective, particularly because the Institute's director, Dr.Oskar Spengler likewise holds a professorship at the University.

A departamental form of organization is maintained with ten divisions - Technical School; Pilot plant; Chemical-Technical; Patents; Analytical; Biochemical; Chemical; Physical; electrotechnical and library.

A diploma certifying the holder as a sugar production engineer was issued by the technical school division of the Institute. Some 30 to 40 students were enrolled each year for the full course. Short vocational

courses also were given on special phases of the industry. The institute, consequently was the means of keeping the German sugar industry supplied with well trained technical specialists.

The analytical department acted as a referee between beet sugar extractors and refiners when discrepancies in sugar content analyses exceed.o5 %. The fact that most German beet sugar extractors do not carry the crude product through the refining procedure involves many inter-factory transactions.

Bomb damage sustained by many sugar factories has intensified the responsibility of the pilot plant department of the institute. Currently, practical investigations are under way on the mergency use of substitute equipment and modified procedures to supplant temporarily the damaged facilities.

The activities of the Institute from 1939 to 1944 are represented in part at least by some 45 reprints of published articles. These appeared as bulletins and are included in Appendix I, Item 1o4 to this survey. Most of the literature issued by the institute was confiscated and this Appendix collection may represent perhaps the only reasonably complete set in the United States at this time. Likewise, the war years publications probably did not reach the United States even in part at any previous time. For these reasons it was thought advisable to outline briefly the subjects covered so that items of special interest might be secured. The titles are summarized for the sake of brevity as follows:

1. Laborator procedure for investigating desirable types of sugar beets by concentrating and crystallizing the factory-delivered extracts. Vol. 89 - 1939 (February).

2. Report on refining procedures and investigations at Schleswig factories Brieg, Hertwigswaldau and Kurtwitz. Vol.89 - 1939 May.

3. Investigations on undesirable sugar beet nitrogenous matter and its effect on the finished Product 89 - 1939 June.

4. Same title as (3) - 89 - 1939 April.

5. A new photoelectric method for Iron determinations and its use in studying iron corrosion in the beet sugar industry 89 - 1939 June.

6. About measuring the volume sugar syrup mechanically Vo. 89 - 1939 - June.

7. Micro methods for determining the harmful nitrogenous matter 89 - 1939 - September - October.

8. Molasses accumulation according to the variation in the polarization and purity of beet juices. 89 - 1939 September - October.

9. Investigations and means of reducing fermentation in sugar beet diffusions. 89 - 1939 September - October.

1o. The composition and quantitative extent of gases in the diffusion stages. 89 - 1939 November - December.

11. Lead acetate soluble nitrogenous matter in the sugar beet as an index to its characteristics and performance in the factory. 89 - 1939 November-December.

12. The Steffen process for removing sugar from molasses. 89 - 1939 November-December.

13. The relationship between the beet proper, the leaves and greens and its sugar content. 9o - 194o January-February.

14. Function of phosphoric acid in the culture of sugar beets. 9o - 194o January, February,

15. Investigations on the press-water developed during the drying of beet chips. 9o - 194o January - February.

16. Investigations on sugar yields of specially cultured beets. 9o - 194o March - April.

17. Determination of sulfites and sulfides in dried beets, Steffen chips and other dried chips. 9o - 194o March- April.

18. Comparative investigations on growth, rythms and differences in ripening of various beet types. 9o - 194o May - June.

19. Quantitative determinations of sugar beet root burn in treated and untreated seeds. 9o - 194o May - June.

2o. Influence of alkali phosphates on calcium removal in thin juices and on incrustation during concentration. 9o - 194o May - June.

21. Colloids in sugar factory products. 9o - 194o July - August.

22. Reuse of regenerated separating slime as a calcium remover in syrup purification. 9o - 194o September-October.

23. Characteristics of Sugar Beet types as classified through the investigation of growth factors by means of an culturing etc. 9o - 194o November-December.

24. Colloids in sugar factory products. 91 - 1941 January-February.

25. Phosphates for calcium removal in the syrup refining. 91 - 1941 - March-April.

26. Investigation of crude juice extraction by means of a continous tower-type extractor made by Harburger Oil Works. Brinckmann & Mergell. 91 - 1941 July-August.

27. Storage of white Sugar special types of Paper Bags. 91 - 1941 September-October.

28. Should Beet seed be treated with fungicides? 92 - 1942 Hans Greis of Rabbethge & Giesecke.

29. Determination of available Saccharose and raffinose content and the rotation of non-sugar constituents in molasses under certain enzymatic inversion procedures. 92 - 1942 May.

3o. Investigations on the purification of crude syrup with the Wo.Ostwald foam separation method. 92 - 1942 May.

31. Laboratory facilities for Investigations on Sugar beets. 92 - 1942 August.

32. Re-use of regenerated separated slime as calcium remover in the purification of syrup. 92 - 1942 - October.

33. Comparative investigations on the purification of crude syrups resulting from frost-bitten beets. 92 - 1942 July.

34. Fertilizing Sugar Beets. 93 - 1943 January.

35. Vitamine content of sugar beets and its preservation during processing. 93 - 1943 january.

36. Investigations on Riesel-diffusion. 93 - 1943 March.

37. The system Hildebrandt (Harburger oil works Brinckmann & Mergell) for continuous counter current extraction as operated in the Stavenshagen factory. 93 - 1943 April.

38. Influence of changing moisture conditions in the soil on yiels and desirability of sugar bett types. 93 - 1943 May.

39. Functioning of sugar beets under changing conditions 93 - 1943 July.

40. Problem of refining crude syrup from frost bitten beets. 93 - 1943 October.

41. Some title as No.38 above. 93 - 1943 November.

42. Barnyard manure as fertilizer for sugar beets. 94 - 1944 February.

43. About the storage life of raw sugars. 94 - 1944 August.

__Research Institute for Starch Manufacture, Berlin.__

This industry-financed establishment maintained extensive research and pilot plant facilities. Heavy bomb damage has crippled the institute and only a very limited activity is in progress at this writing.

The general program of the institute was directed along the following lines -

1) Raw material studies; improved agricultural methods for potato culture; examinations of new raw materials; storage of potatoes.

2) Technology of Starch manufacture including all phases of scientific, technical and administrative services in the factory - standards of quality, improvement of yields, development of new methods of production, cost statistics, packaging, a storage comparative analytical data for the industry etc.

3) Technology of the Uses for starch by customers of the industry - scientific and practical plant service to the trade, this service based upon the same general considerations as listed in (2).

4) Technology of Potato dehydration and various products.

5) Cooperative development work with the German national potato grange.

6) Contacts with government officials in the various food offices and agricultural experiment stations.

A booklet entitled, "Responsibilities and facilities of the Research Institute for Starch Manufacture", desribes the activities in detail and includes illustrations. This booklet is filed in Appendix I to this Survey. The interruption of Institute publications exchanges with the United States during the war led to an urgent request by these investigators for a 1939 - 1945 collection. However, severe bomb damage and confiscation of other materials resulted in our securing only a partial list. These reprints and final manuscript of an unpublished article are filed in Appendix I, Item 1o5 to this survey.

The titles of these various articles are summarized as follows:

1) A review of most recent manufacturing technique for Potato Starch production. Kröner. Vol. 6 p. 183 - 189. 194o (Verfahrenstechnik).

2) Protein contents of frozen potatoes. Kröner-Volksen, Zeitschrift für Stärke und Trocknungsindustrie Vol. 44 - 194o.

3) Report of the Work of the Research Institute for Starch Manufacture - 23 May 1939.

4) Address of Dr. Kröner on the Development of the Research Institute for Starch Manufacture 1935 - 1939 (A Bulletin).

5) The distribution of Vitamin C in the Potato and its importance in the preparation of Dehydrated Potatoes. Vol. 2 and 3 - 1939.

6) The use of Potato starch meal for the preparation of Cream fillings. Vol. 22 1939.

7) Investigations on commercial starch syrups. Vol. 9 and 1o 1939.

8) Gleaning Potatoes in the Starch Factory. Vol. 25 - 194o.

9) Experiences with the Viether unit for obtaining proteins from Potatoes. Vol. 18 - 2o, 1939.

1o) Gas formation in Potato Starch Manufacture. Vol. 7, 194o

11) Selection of Potato Varieties for Dehydration. Vol. 5 - 1941.

12) Determination of anhydrous solids and protein content of potato juice. Vol. 19 - 1941.

13) Constitution of the Potato Fat content (Special short bulletin reprinted from "Die Naturwissenschaften, vol. 3o, 31 - 1942.

14) Determination of Ascorbic and Dehydroascorbic acids in Potatoes. Biochemische Zeitschrift Vol. 4 - 1941.

15) The Potato. (1942) col. 9. (A 13o page bokk by Drs. Kröner and Völkers).

16) Relations between total solids, refraction and viscosity in starch hydrolysates. Zeitschrift for analytische Chemie, Vol.122 (9-1o)

17) Distribution of Ascorbic Acid in vertain plant segments. Biochem.Zeitschr.314, 4o9 - 1943.

18) Aroma and Taste factors in Potatoes. "Die Naturwissenschaften" Vol. 38-39 (1942).

19) Use of activated charcoal in Starch-sugar syrups. Institute Reprint - vol.2 see 9-1o (1943).

2o) Physical and Chemical Problems in Potato Dehydration. Vol.4 - see 3-4 (1941)

21. Significance of anhydrous content determinations in Potatoes and Starches. Vol. 3 - see 1 - 2 - 194o.

22) Questions about Standardization of Analytical methods in the starch products field. (Reprint translating address in French at International Agricultural Congress, Budapest 1939).

23) Blanching technique with respect to potato dehydration Vol. 2, see 8 - 1939.

24) Potato peeling as an industrial, technical and scientific problem. (A typewritten final manuscript, 23 pages by Drs.Kröner and Völkers.

25) Reducing action of Potatoes with 2,6 Dichlorphenol indophenol during dehydration. (in the plant) col.4 - see 11-12, 1941.

26) Same title as above except - in the laboratory. Vol. 4 - see 9, 1o, 1941.

27) Making undiluted Potato juice. Vol. 2 - see 1, 1939.

28) Sulphurous acid containing Dehydrated Potatoes. Reprint from "Die Ernährung"- vol.4 - see 7, 1939.

29) About the swelling properties of dehydrated Potatoes in water. Vol. 3 - see 9 - 1o, 194o.

3o) The question of Vitamin C content in Dehydrated Potatoes. Reprint from "Vitamine and Hormone" vol. 1 p.289, 1941.

31) Comments on the work of von Suaersen and Orth on the distribution of Ascorbic acid in Potatoes. Reprint from: Untersuchung der Lebensmittel. Vol. 85 - see 2, 1942.

32) Evaluation of Investigational methods on Starch Syrup. Vol. 2 - see 1, 1939.

33) Obtaining Potato Proteins by precipitation under heat col. 2 - sec. 4, 1939.

34) Discoloration of Hydrochloric acid hydrolized Starch - Sugar solutions during neutr a-lization. Vol. 2 sec. 7, 1939.

35) The situation as to Protein Yields in Potato Starch factories. Vol.8, sec.4, 1939.

36) About Discoloration of the Syrup during Starch Hydrolysis. Reprint from "Forschungsdienst - Organ der deutschen Landwirtschaftswissenschaft" Vol. 9 sec. 6, 194o.

37) Observations on the stability of Ascorbic acid in solutions of digestive ferments. Reprint "Vitamine and Hormone" vol. 4 p. 182, 1943.

38) The effect of Potato juice on metals. Vol.5, sec. 7 - 9, 1942.

39) About the reducing properties of stored, dehydrated potatoes. Reprint - Vitamine and Hormone. Vol. 4 p. 173, 1943.

4o) About the stability of Ascorbic Acid. Vol. 4, sec. 5 - 6 1941.

41) Determination of Ash in Starch Products. Vol. 4, sec. 5 - 6 1941.

42) Effects of Storage on Starch Kernels in Potatoes. Reprint from "Landwirtschaftliche Jahrbücher". Vol. 92, sec. 4. 1943.

43) Comparative physical-chemical examination of cellar stored and warehouse stored potatoes. Reprint from "Vorratspflege und Lebensmittelforschung", vol. 4, sec. 9 - 1o, 1941.

44) About the reducing action of cellar-stored and warehouse stored potatoes on 2.6 Dichlorphenol-Indophenol. Vol. 4, sec.9-1o, 1941.

SECTION X.

BRIEF OUTLINE OF CIVILIAN FOOD RATIONING IN WARTIME GERMANY

REPORTED BY

W. G. SRAUB

Brief outline of Civilian Food Rationing in Wartime Germany.

General Aspects.

Perhaps the most significant feature of German rationing, as viewed from the more liberal American attitude, is its extreme thoroughness - which reached down even to the minimum number of eggs that every regimented hen must deliver. Strict controls were enforced on all rationed foodstuffs, including every major item, from production on the farm through processing and trade channels to consumption in the home or restaurant.

The German farmer had some advantages over city dwellers but was limited to his per capita share in relation to the current civilian allocation, irrespective of how much more he produced or what his habits had been in the past. He was held responsible for the delivery of specified quantities of foodstuffs based upon a careful inventory of his live stock and acreage planted. No ration cards were issued to him for foods produced and therefore no opportunities were created for transfer of superfluous ration currency to relatives or friends. The detailed follow up of foodstuff deliveries from the farm prevented black market operations. Germans now claim that few if any such violations occured in Germany during the war.

Another important feature of German rationing was the early recognition of differences in food needs of individuals in various occupations. Interestingly enough, this same principle was applied by the army most thoroughly, with regard only for calorific requirements of the troops irrespective of rank. Civilian-wise it is rumored, however, that influential party members managed to secure extra food and the very scarce luxuries. Ration cards were issued in three classes according to the degree of physical exertion required to accomplish the workers' daily task. Definite weights of definitely specified foods, allowing for substitution only as actual shortages required it, were provided. The point rationing system used in the United States, which allowed a wide choice of foodstuffs, had no counterpart in Germany

Administrative Plan.

A choice of food stores with the advantages of shopping around at various retailers, which fortunately under the U.S. system the American home maker could enjoy, was prohibited. Each family was registered with one retailer and bound exclusively to make all food purchases from him. The retailer in turn could buy from one wholesaler only and both made regular monthly reports to the district food office. The wholesaler was allowed to purchase only from farm marketing associations and food processors within the district controlled by the district government office. This office had full information on all rationed foods on inventory within the district at the beginning of every month, deliveries made by local producers or shipped in during the month; the quantities distributed through ration cards during the month; the number of persons who held cards, and existing food inventories at the end of the month.

The channels leading from the district office to the individual city or village control offices provided for farm production quotas, registration of all types of live stock and actual deliveries credited to farmers and acreage details. Thus, each district office which controlled a definite number of cities, towns and villages and which was headed by a District Leader could render full operating reports to the Provincial Food Office. One such Office was maintained foreach of the provinces , Bavaria, Württemberg, Baden, Rheinland, Pfalz, Hessen, Thüringen, Sachsen, Westfalen, Oldenburg, Hannover, Brandenburg, Mecklenburg, Pommern and Holstein. This office in turn reported to the Reichs Food Office at Berlin.

The various district offices within the province first arranged to fill each others food deficiencies up to outstanding ration card requirements to assure the shortest haul. Thereafter supplies were equalized between provinces by the provincial offices to compensate for heavier production of various types of foodstuffs or larger processing operations in the different sections of Germany. The head office at Berlin determined allocations after studying the supply picture and coordinating it with military needs. A reasonably equitable distribution of foods from a calorific standard was main-

tained throughout Germany until Allied air raids seriously affected transportation.

Bonus distributions were made during the usual 28 day period covered by the ration cards if supplies permitted, - special items such as soap, coffee, tobacco, cigarettes, cigars, etc., were made available at times. Additional rations of certain items were provided for children, expectant mothers and in cases where medical approval had been given, presumably by prescription.

The counterpart of our volunteer manned local ration boards in the United States was the village or town food office. It was headed by a prominent farmer who supposedly could judge reports from others as to live stock owned and acreage planted and who also assigned delivery quotas. The local Burgomaster and the ranking Nazi party leader completed the membership of this volunteer board. All served without pay for the work. In the case of larger villages or cities, a staff of volunteer assistants and paid clerical help was maintained. This group had quthority to punish farmers who failed to meet their quotas by withholding cards for sugar, tovacco, coffee, soap, etc. Continued violations brought quick and heavy punishment from higher levels and could lead to confinement in concentration camp.

Fresh fruits and vegetables were not distributed through the use of ration cards but the retailer was held responsible for equitable allocation among his registered customers. Timely radio and newspaper publicity advised the public of its share of these foods and monthly reports by the retailer confirmed the fairness of their allocation.

It is claimed, and probably with some justification, that this all-encompassing rationing masterpiece (although a horrible example of complete regimentation) maintained the morale of the people sufficiently high to enable this normally food-deficient country to prolong the war beyond all expectations. Food plundered from other nations was obviously a factor too, but here again the system spread those supplies most efficiently.

Food rationing in Germany must continue for a long time. Food production and distribution has suffered greatly during the war. Lack of fertilizers, labor and machinery on the farm; lack of feed necessitating live stock depletion; lack of transportation due to bomb damage.

Furthermore, lack of labor at the mines, and transportation difficulties caused an acute coal shortage which has reduced the volume of food processing operations.

<u>Further Details on Ration Card Technique.</u>

Ration cards were issued, and continue to be issued at this time to cover a 28 day period. Each period is known as a "Versorgungsperiode", - the period which provides. As of 24 August 1945, the 79th period in German food rationing was in effect. The actual quantities of food allocated to German civilians in Munich (as listed by the Bavarian Food Office) during this most recent period ending 16 September 1945, may be of interest:

)aily Ration	Normal or light workers		Heavy workers		Heaviest workers		Displaced persons Antd-Hitler Germans Recuperating conc.camps	
	grams	cal.	grams	cal.	grams	cal.		
read	260	598	360	828	410	943	392	910.6
eat incl.sausage)	42.8	77.14	57.08	102.74	71.35	128.46	64.28	115.70
ats (butter, leo, oils)	14.27	107.14	14.27	107.14	32.12	240.9	32.14	241.05
heese	4.46	15.16	11.15	37.91	4.46	15.16	4.50	15.30
urds	4.46	5.08	4.50	5.10	4.46	5.08	4.50	15.30
ereals, etc.	14.28	46.26	14.28	46.26	14.28	46.26	14.28	46.26
otatoes	490.	308.50	490	318.50	490	318.50	571.42	371.42
igar	10	40	10	40	15	60	10	40
egetables	50	7.5	50	7.5	200	30	210	30
lour	13.39	42.85	13.39	42.85	13.38	42.85	13.39	42.85
armalades	-	-	10	22	10	22	-	-
resh Milk	-	-	-	-	-	-	1 ltr.	250
.E.M.	3.5	-	3.5	-	3.5	-	3.5	-
alt	4.0	-	4.0	-	4.0	-	4.0	-

All persons may augment the typical ration just described through the purchase of unrationed fresh fruits and vegetables if these are available. Persons who convert what is ordinarily not classified as farm land into vegetable gardens are not required to give up any of their produce. During the war, both farmers and non farmers who raised chickens were permitted to keep the eggs from one hen per each member of the family but their egg ration was removed from the cards.

Changes in Ration Cards, 1939-1944.

Ration cards are printed on different colored stock for each period. From 1939 to 1944 individual cards were printed for each major foodstuff showing the kind and quantities involved. Accordingly, separate cards were issued for meats, bread, fats, sugar, etc.

Since 1944 these individual cards have been replaced with a single card containing the greater number of all the rationed items. Originally, these all-inclusive cards carried no names of foods but, instead, a cipher system. The head office by public announcement specified which numbers would be removed to secure each particular item and the amount of that item allocated for the 28 day period. Since the 78th ration period which began 23 July 45, however, part of the food list was shown by name and part by numbers. The major items which appear on this modified card by name are to be procured automatically by cutting out that name imprinted area during the period. The number imprinted areas on the same card, however, represent foods which can be procured only after public announcement has been made. This makes it possible to give the card holder the basic ration for the period without confusion of numbers and likewise permits the issuance of additional supplies or

special items as available during that month. Both consumers and dealers claim, however, that the substitution of product names for all number areas on the card would simplify its use.

Cards for Various Age Levels:

Up to 1944, six different calsses of these basic ration cards were issued, each with varying quantities or items depending upon the needs of the age group involved. Cards of different make up were in force for the following age levels:

1. Children up to 3 years old.
2. Children aged 3 years to 6 years.
3. Children aged 6 years to 10 years.
4. Children aged 10 years to 14 years.
5. Youth age group - 14 to 18 years.
6. Adults, - all over 18 years of age.

This elaborate age classification was simplified in 1944 by reducing the number to only three age groups:

1. Children up to 6 years of age.
2. Youth group - 6 years to 18 years old.
3. Adult group - over 18 years old.

Farmer and Non Farmer Cards.

It will be noted from the earlier general description of the German rationing principles that a further subdivision of these classes must be made, as farmers and non farmers are rationed with equal strictness. Therefore, for each of the above age groups two very different types of cards are necessary - one for self sufficient individuals who produce their own as well as surplus meats, grain, butter, milk, etc., and another for the dependant group who must buy these major foods.

Farmers who produce their own milk but do not slaughter live stock have the milk ration trimmed from their cards before issuance, but the meat coupon remains. Cards are trimmed at the final local village office in accordance with the nature of the farming activities of the holder. One liter of milk per person in the family is allowed the dairy farmer and is credited to his delivery quota. The average dairy farmer was not permitted to churn butter during the war but received his allocation from the creamery where he delivered his milk quota. At this time he received 760 grams of butter per 28 day period giving him some advantage over the city residents. However, he

could not purchase other fats of any kind or any other foods from any parts of Germany, except sugar. Small farmers in the mountain section of Germany who produce more milk and meat per acre since the land is largely in pasture, are permitted a larger allocation because it is limited practically in its entirety to pork. Only the very largest farmers slaughter cattle. The family of the small farmer may consume 40 kilograms of pork per person (88 pounds) in a year and children under six 20 kilograms. Farmers who produce rye and wheat are returned their share of flour by the mill, including the fodder by-products for feeding pigs. If such farmers do not bake their own bread, or perhaps produce only one of the grains for the flour mixture, they receive bread ration cards and are not returned any flour by the mill.

Perishable Food Coupons.

Early in the operation of the German rationing system a series of coupons was printed on the ration cards to cover every perishable item. This purchase order for each individual perishable foodstuff was filed with the retailer at the beginning of the 28 day ration period by the consumer. The retailer conveyed all these coupons from all his customers to the local food office and received written authority to buy the aggregate quantities represented from his wholesaler. This prevented inequitable distribution of the perishable foods as obviously each householder would clamor for her coupon share. Likewise, as the consumer was bound exclusively to one retailer and as retailers reported names and addresses to the local office there was little opportunity for irregularity. However, the details connected with listing many individual items led to simplification. At this time, only the most perishable items are handled in this manner - milk and eggs. Skimmed milk for adults and whole milk for children up to six years of age are printed as purchase coupons with one milk dealer at the beginning of the ration period. As each daily purchase of milk is made by the consumer, the dealer cancels one of the 28 squares on the milk coupon.

Special Cards For Heavy Physical Work.

The extensive use of differential rationing in Germany is of interest, perhaps, because of a much more limited counterpart in the United States. This principle of differential rationing was recognized right at the outset in Germany and was applied universally.

The so-called "heavy" and "heaviest" workers receive ration cards which are divided into four sections - one for each week. This weekly division-instead of the single 28 day form - is to take care of changes in the workers immediate task. For example, certain workers, without any change in their place of employment, would be doing heavy work only one or two weeks out of four, on the average. In the interim, while on light work, their ration was smaller. The calofific differences for various classes are shown for the current ration period earlier in this report.

Special Daily Ration Cards.

Early in 1945, a so-called daily ration card was issued. Such cards afford rations for one, two, three and seven days. They are intended for special uses. For example, if a person enters a hospital for a week or two he must surrender his 28 day ration card while confined since the hospital receives rations on an institutional basis. Upon leaving, he needs personal rations again and the daily card is convenient for this purpose. Travellers also may use such cards after approval by the local office. If a person or family should move from one province to another, transportation permitting, especially to Bavaria where rations are higher, the daily card is very convenient to carry on until the new 28 day card is issued.

Additional Rations for Pregnant and Nursing Women.

In addition to her regular 28 day ration card the expectant and the nursing mother receives a "mother card". She

is permitted a selection from two specified cards and usually makes the choice upon advice of her doctor. One card provides more cereals and the other more fat, but both cards authorize one half liter of whole milk daily. These additional rations are issued for a number of months before and after the birth of the child in accordance with the physicians' recommendation.

Special Cards for Medical Cases and Restaurant Use.

Special rations are permitted according to a physicians' prescription for certain cases. Originally, specially printed cards were made available for medical cases, but this procedure has been simplified by issuing small coupons.

Persons who eat regularly in restaurants use these coupons. The inn keeper receives his food supply from the wholesaler by presenting such ration currency.

Reporting Procedure In Production and Trade Channels.

Each farmer declares his holding of all kinds of live stock, poultry, etc., and acreage planted at the village rationing board office. He receives a receipt for all deliveries to the local farmers marketing association or food processors. Both in turn report his deliveries along with all othersto the district rationing office and also their deliveries to whole-salers or other processors.

The wholesalers report monthly receipts from producers and processors, and likewise monthly deliveries to retailers. They surrender ration currency which they receive from the retailers to their suppliers.

Retailers transfer the ration currency received from consumers to wholesalers by pasting it on paper sheets. The dealer also reports the number of individuals in the families he served during the 28 day ration period and the total of various rationed foods he sold. This report also goes to the district office. District offices report to provindial offices and so the information reached the Reich Office at Berlin.

Exhibits.

One complete set of the various ration cards currently in use in Germany at this time are available for inspection as Appendix I, item-106 of this report.

Appendix I - Item 106.

Comparative colored chart of 1939 food allocations to various military and civilian personnel

Appendix I.

As Appendix I are included all items of information relating to this report which could not be included in the appendix because of its size, volume or physical nature (e.g., microfilms, etc.). All these items have been identified by an identification slip referring to this report and shipped to the Office of The Quartermaster General, Washington, D.C.. Following is a list of the items involved with their titles or descriptions.

Item.	Subject
1.	Brochure on the can manufacturing operations equipment of the I.A.Schmalbach Co., Braunschweig. This brochure was sent to OQM by letter of 9 July 45.
2.	Ditto for the Günther-Wagner Can manufacturing company of Hannover. As stated in the report, this brochure must be collected from TIIC, London.
3.	Panels of metal plates showing the various types of substitute tin plates used or tested in Germany during the war. Prepared by J.A. Schmalbach Co., Braunschweig,
4.	Eco-Maschinensatz, Jagenberg-Werke, Dusseldorf.
5.	Fabrikationanweisung, Josef Pankofer, Co., Munich.
6.	Gefrier-Taschenbuch, VDI, Berlin.
7.	Beiträge zur Kälte- und Lebensmitteltechnik, VDI, Berlin.
8.	Kühl- und Kälteeinrichtung bei der Heeresverwaltung für 1944.
9.	Storage for frozen foods, Linde, Wiesbaden.
10.	Table for cellophane wrapping, Andersen Co., Hamburg.
11.	Parchim freezing plant layout, Andersen Co., Hamburg.
12.	Markee freezing plant layout, Andersen Co., Hamburg.
13.	Drawing of refrigeration plant, Andersen Co., Hamburg.
14.	Layout of tunnel freezing plant, for Andersen by Linde, Wiesbaden.
15.	Ammonia piping diagram for tunnel freezer, Linde, Wiesbaden.

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68. Merkblatt for the field cook.

69. Merkblatt-information on vitamins.

70. Merkblatt-potatoes as food for the Army.

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APPENDIX II.

A Treatise on the Porosity of the Surfaces of processed Food Cans made of Sheet Steel.

(Korrosion u. Metallsch. 20. Jan. 1944, No.1).

By Dr. E. Nehring, Brunswick.

A treatise on the porosity of the coating for materials used in the production of processed food cans has to take into account the fundamental fact that the metals which may be utilized for processed cans cannot be used without a coating or may be used only in exceptional cases. The high susceptibility to corrosion of those kinds of steel which, for various economic and material reasons, can be utilized, is well known. In view of the great importance of steel in this field, this treatise deals exclusively with that material. As for the canned goods, only vegetables are taken into consideration, as they represent the bulk of canned goods and because they may well serve to show quickly and precisely the limitations of the various kinds of coating. This survey is based on experiences and results obtained in the fundamental research work which was made on behalf of the high command of the German army with a view to manufacturing cans without a tin-coating. The need of supplying the Wehrmacht with flawless cans made it necessary to supplement strongly all theoretical considerations with practical experiences.

The coating for cans has to meet many requirements. The inside of the cans is exposed to corrosive influences which are continually changing even in one and the same kind of vegetable or food due to natural changes in their chemical composition and varying methods of production and storage. Acids are incessantly acting on the material used. Defects such as the porosity of the coating cannot be mended after the cans have been sealed and they can only be detected after the preserved food has been utterly spoiled or damaged to such a degree (for example through chemical swelling) that it cannot be used for the supply of the Wehrmacht or for the civilian sector.

In order to make possible a proper distinction between cause and effect in regard to the porosity of the coating of steel-plate cans it will be necessary to define the term "porosity". By "pores" we mean those defects in the coating which are due to imperfect production or which are caused during transportation, storage, or canning. Accordingly, a distinction is made between primary and secondary porosity. Their effect on the durability of the canned goods is the same.

I. The Metallic Surface Protection of Steel with or without an Organo-chemical Coating.

A. Tinned steel-plate unlacquered.

The Process of Production.

The knowledge on the part of the reader of the process of production of tin-plate is assumed.

Causes of Porosity.

By tin-plate we mean the kind which, on the average, contains thirty grams of tin per square meter on both sides of the plate. The tin-coating, with the exception of a few first class products, shows a considerable amount of porosity. Up to the outbreak of World War II there was no tin-plate available on the world market which was entirely free of primary pores. There is an abundance of research work both German and foreign on the causes of primary pores.

The main causes are:

The generating of hydrogen in the pickling process.

The surface condition on the black iron sheet.

The degree of purity of the tin bath.

It is doubtful whether tinned steel plate is actually porous as this term has been defined above, because there is the possibility, especially in sheet plate tinning, that enclosures of tin mixtures containing iron are formed, concentrating in the hearths while tinning.

A secondary porosity occuring in rolling mill production is caused by the cleaning process after tinning. But the porosity formed during transport, and especially in the production of cans is far more extended. Frequently the thin tin coating is damaged by the sharp edges of the plates or plate sections. The heaviest strain for lid and bottom is produced by stamping (Eno profiles) indispensable for stiffening this part of the cans. The extent of damage depends on the kind and quality and adjustment of the tool. But also the ductility of the base material plays an essential part. Plates which can be deep-drawn with difficultly, show after the fast deep-drawing of the stamping, greater porosity than the fine grained materials. We must mention, however, the great damages caused on the surface of the tins produced by the sharp letters or by the stamping of numbers which are punched by the preserving industry into the cans to distinguish the different contents.

Effect of Porosity.

When we analyse the porosity of tin-plate by using the potassium ferricyanide method we cannot say for certain whether the porosity corresponds to the definition mentioned above. Apart from the possibility of a sham porosity we cannot find out whether the intermediate (alloy) layer (consisting of iron and tin which is formed when tin is hot dipped and which probably reacts with potassium ferricyanide) is damaged and the iron base is uncoated or whether the damage has only reached that layer. It must be left to physico-chemical studies to find new methods of analysing these two possibilities of the porosity of tin-plate. This seems to be all the more important as the intermediate layer plays a great part in the corrosion resistance of tin-plate.

The effect of this porosity compared with that which is ordinarily found in cans brought on the market is insignifident. If this were not the case, tin-plate would not have played an important role as the only material for cans up to the outbreak of World War II and that for over half a century against all attempts to displace it. If atpresent it is dethroned the reason is not the want of quality, but the impossibilty of supplying it.

The reasons are well known. Tin combined with iron has an anodic effect when brought into contact with many vegetable acids. Thus the increased corrosion of iron which might be expected according to the electromotive series is neutralised; the tin reacts as a less noble metal and protects the iron from being dissolved.

Knowing the inconsiderable effect of porosity one did not lacquer the cans (tin plate) containing vegetables that did not become acid; in this connection, no difficulties in European trade with tins were observed. Porosity only was noted when carrots or celery were stored for more than two years. Both vegetables are the typical representatives of tin and iron aggressors. For all the important vegetables the porosity of unlacquered tinplate is not detrimental; it is only through the formation of ferrous sulfide in connection with vegetables yielding hydrogen sulfide or compounds containing it during sterilization that the well known black marbling (staining) of the walls of the cans appears, which, practically, is without any depreciation of value of the contents.

The situation is quite different when the cans are filled with fruit. In this case chemical swelling may be due to the porosity in connection with any kind of fruit that is strongly corrosive caused by the dissolving of the iron. In this case only lacquered tin-plate was used.

B. Cylinder lacquered tin-plate.

Process.

Knowledge of the process of production is taken for granted.

Causes of porosity.

The causes are practically the same as described in the case on tin-plate. One must therefore take into account primary and secondary porosity both of the tin and the lacquered layer.

Effect of porosity.

The effect of primary and secondary porosity is only then of decisive importance for the durability of the cans when the pores of the lacquered layer concide with those of a tin layer, i.e., when the damage reaches the iron layer. The effects of these damages may appear as pore corrosion (pits) or as formation of hydrogen. The electrolytic protection produced by the combination of tin and iron is screened by the lacquering so that the iron is dissolved and there may appear pore corrosion at the porous spots, especially at the lid and the bottom of the cans. If, owing to a high porosity, many places of the inner walls of the can are exposed to the aggression of acids, swelling caused by hydrogen generally appears.

The surface protection of tin-plate by lacquering according to the cylinder or roll lacquering process, is more than problematic on account of the inevitable damage. It can only be justified when, involved by porosity, the plain tin-plate, owing to a weak development of hydrogen (not sufficient to cause swelling) would leads to reduction in the pigment of colored canned goods. Thus, when fruit preserves are to be kept for an unlimited period, similar requirements mus be made with regard to the coating of tin-plate as discussed below for the surface protection of black sheet-iron.

C. Steel-plate tinned galvanically.

Production.

The knowledge of the process of production is assumed.

Causes of porosity.

The same as described in the case of tinplate, only because of the thinner layer of tin, which is about 10 to 12 grams per square metre, the primary porosity is much higher than with tin-plate.

Effect of porosity.

The durability of cans tinned electrolytically is, with regard to the different canned goods, limited by the same factors as unlacquered tin-plate, except that the durability is shortened owing to the above mentioned greater primary porosity and owing to the missing intermediate layer of tin combined with iron (alloy layer) By

the lacquering, even by cylinder lacquering, damage caused by porosity may in the case of slightly acid canned goods such as vegetables, be so far repressed that the durability is equal or nearly equal to that of tin-plate.

The use of material tinned electrolytically and cylinder lacquered for canned goods which are strongly acid such as fruit, pickled vegetables, etc., is not advisable. Owing to the thin layer of tin, the possibility that the pores of the layer of lacquer coincide with those of the tin-coating is much greater than with tin-plate. Consequently, one must reckon with damages that are much greater and appear within a shorter period than those mentioned for cylinder-lacquered tin-plate.

D. Bezidit.

Production.

As to Bezidit as brought on the market, it is very slightly (remelted) tinned sheet-metal with layers from 10 to 15 grams. The protection of the coating resembles that of tin-plate. The ability of the tin-iron alloy intermediate layer to protect the sheet-iron ahainst corrosion can be proved.

Causes of porosity.

The causes of porosity are the same as described for material tinned electrolytically and for tin-plate. On an average, the porosity is less than with black sheet-plate electrolytically tinned, but it is not so slight as in the case of tin-plate.

Effects of the porosity.

The material represents an intermediate member between galvanically tinned sheet-steel and tin-plate. Used without a further coating it almost equals the durability of tin-plate in the case of only slightly acid goods, like most vegetables. Experiments made with food a stronger acid character have shown good results when the plate was cylinder lacquered. In this case the cans lasted for more than a year without showing any signs of beginning swells or pore corrosion. Should this kind of plate, however, be used in large quantities for canned fruit, a higher percentage of spoiled cans may be expected than are found when ordinary or lacquered tin-plate cans are used.

The tin-coating for electrolytically tinned sheet-steel and, according to information given by the producers, also for bezidit may be produced at any desired thickness. In this treatise we have only taken into account the war-time qualities.

II. The organic Surface Protection of Steel.

We have shown in this survey the significance which porosity has for the metal surface protection of steel against the influences of canned vegetables, and we have tried to prove that only the electrolytic effect generated by the combination of tin and iron is able to suppress the highly corroding influence which the acids of canned goods have on iron. Furthermore, we have dealt in this connection with the problem of giving steel a double protection by using tin and an organic coating. It will easily understood that the highest requirements have to be made with regard to porosity when considering an organic coating alone as a surface protection for steel. The following requirements have to be made:

Every kind of organic surface protection for steel has to be absolutely free of pores, if the durability of tin-plate in the storage of acid goods is to be equalled or surpassed or if the sheet-steel is to be used for every kind of canned goods.

Carrasco proved by experiment that in weak organic acids the behaviour of lacquered sheet-iron to bare-sheet-iron is similar to that of tin to iron, that is to say the lacquered sheet-iron becomes anodic. However, there is no case known to him from practical experience which might prove the existence of this protective effect and therefore his statement is only of theoretical importance.

Carrasco mentions two factors which, apart from the porosity, tend to make black sheet-iron protected by an organic coating more susceptible to corrosion. The first of these factors lies in the tendency of the lacquer to swell and this leads to osmotic and dialytic processes. When the coating is swollen and therefore permeable, certain electrolytes and gases may be expected to come into contact with the metallic surface.

This source of decomposition over and above that entailed by the porosity of the coating is to be considered as very important. It is, however, not enlarged upon in this survey as that would make it necessary to give an account of the composition and physical qualities of all possible and usual systems of organic surface protection. The publication of the experiences made in this connection will have to be postponed till after the war.

According to the same author, the speed of corrosion and therefore also the effect of the porosity are strongly influenced by those secondary electrolytical processes which are caused by the chemical composition of steel. His frequently expressed demand, however, to improve the resistance of steel to corrosion by lessening the admixture of carbon and sulfur or his demand to turn steel from a variable into a constant factor by providing for a constant chemical composition will remain unfulfilled at least as long as the war continues. In the research work which forms the basis for the following survey, Thomas-steel was used. All the other kinds of steel are out of consideration for investigations during the war.

A. The cylinder-lacquered sheet-iron.

The coating of this material is made up of two layers of lacquer. Depending on the kind of preserved food in question; the second, that is to say the surface layer, may be a sulfur-proof lacquer containing zinc-oxide. This material will better serve to show the cause and effect of porosity than the following.

Causes of porosity.

All those possibilities of damaging the surface which have been mentioned above in connection with other kinds of coating have again to be taken into consideration. But as in the case of all formerly discussed methods of protecting the surface of sheet steel, we are only concerned with those causes of porosity which are of fundamental importance. The flawless carrying through of cylinder-lacquering, phosphatizing and dip- or spray-lacquering is taken for granted.

It would lead far beyond the topic of this treatise should we discuss the kind of porosity that may be caused by a slovenly management of the process of production. Porosity of that kind may quickly be lessened by just demands made by the recipients of the cans in regard to their quality. In order to prevent this kind of porosity no additional methods of production need be used. It is a fact, moreover, that the porosity caused in this way is of a far smaller significance than the basic sources of porosity.

Cylinder-lacquering was only used as a transitionary means of surface protection for sheet-iron. With this kind of coating two causes of porosity had to be eliminated from the start; the lacquer-coating of rusty plates must be very porous and there is the danger that the oxide-layer will even spread underneath the lacquer-coating. The lacquering made in the rolling-mill soon after the rolling of the sheet-iron excludes this cause of porosity.

In a one-layer cylinder-lacquered coating the primary pores expose the surface of the steel-plate. A double layer of lacquer coating lessens this deficiency in as much as it may be expected that the primary pores of the two layers do not coincide. The double lacquer coating does not provide a diminuation of the secondary porosity - or in other words, a strengthening of the resistance of the surface protection in regard to mechanical damages.

Cans of cylinder-lacquered sheet-iron are soldered Therefore, the porosity formed by burning the lacquer at the soldered side seam plays an essential part. There may be added the damages of the coating caused by fixing lid and, bottom, dependent on the quality of the lacquer and its working up in so-called lid and bottom channel. Both kinds of damages are not limited to the surface of the cylinder-lacquering, but act on the ground layer and up to the iron. Furthermore the porosity caused by the stamping of lid and bottom is important.

Effect of porosity.

The stability of cans of cylinder-lacquered sheet-iron to slightly acid goods (un-acidified vegetables) is limited to 6 - 16 months according to the corrosive action; the cans are not to be used for acid goods. (Number table 1).

Table I.

Average Stability of Important Kinds of Vegetables and Fruits in Cylinder-(Roll) Lacquered Black Iron.

Peas	12	months
Beans	8	"
Turnip-cabbage	9	"
Carrots	6	"
Spinach	6	"
Plums	2	"
Apple sauce	4	"

The corrosion in most cases begins at the side seam and at the lid and bottom channels provided that no coarse mechanical damages exist on the unshaped surfaces. At these parts, the acid penetrates under the coating and lifts it off by formation of hydrogen in the neighbourhood of the starting spots (cp. Picture 2). Increasing of the free iron surface by proggresive corroding action does not bring increased pore corrosion. The damage is to be seen in a swell caused by hydrogen and solution of iron whereby the taste and appearance of the canned good is badly influenced (cp. number tables 2 and 3).

Table 2.

Iron Content of Important Kinds of Vegetables and Fruits in Cylinder-lacquered Black Iron Cans.

Peas	after	24	months	mg/kg	90
Beans	"	24	"	"	205
Turnip-cabbage	"	24	"	"	115
Carrots	"	24	"	"	325
Spinach	"	12	"	"	163
Plums	"	8	"	"	459
Apple sauce	"	15	"	"	512

The suddenly occuring losses caused by porosity are shown in the following curves based on pre-war tests, which are fully confirmed by practice. (Figure 4).

One must take into account that the curve may be displaced to a considerable amount according to the properties of the lacquer, its method of formulation,. the composition of the canned goods and the kind of storage (temperature agitation).

The far reaching damages (secondary porosity) to which the material having surface protection by means of cylinder-lacquering is exposed in a very different manner when manufacturing and can only be rehoued by an after-treatment of the finished cans. Two methods have been developed:

1) the phosphatised, dip lacquered can
2) the cylinder-primed spray-lacquered can.

In both cases it is the question of welded cans, because of the high baking temperatures of the lacquens.

B. The phosphatised, dip-lacquered can

Process.

Welded lower parts (bodies and factory ends) of cans are manufactured from unlacquered sheet-iron and are phosphatised after passage through degreasing and rinsing baths. After rinsing and drying, the phosphatised cans are lacquered by dipping or pouring. The baking of the lacquer is carried out in an adjoining drying room. The ends are manufactured in the same manner.

Causes of porosity.

Distinction must be made between the porosity of the phosphate layer and lacquer layer. According to the observations of W. Machu about 0.3 - 0.5 % of pores must be assumed on the surface after phosphatising. This "natural" porosity is considerably increased by the porosity on the bottom end channel always observed in the manufacturing process. The phosphatising bath does not always penetrate into these parts of the steel where very fine canals heva been formed during processing. As the surface of the steel becomes brittle by phosphatising, the brittleness varying in wide ranges on account of the very different crystal formation, the phosphate layer on the inner side of the end, at the end channel, is often broken in the seaming operation.

The lacquer coating consists of one layer. For reasons not to be dealt with here, the thickness of the lacquer coating is limited, considerably below 20 g per square metre; therefore, the complete covering of the welded edge, having a thickness of 0.27 mm according to the thickness of the plate, is not possible by lacquering. In the one layer lacquering process, also, the end channels do not receive a poreless coating. Surely the phosphate breakage in the end channel caused by the brittleness of the phosphate crytals is often connected with a breakage of the coating. It may be added that with one lacquer coating pores must be always expected on the broad surfaces of the inner walls of the can. It depends upon the condition of the surface to be lacquered, the covering capacity of the lacquer and other variable reasons, to what extent this porosity is formed.

Furthermore, there may be mentioned the porosity of the lacquer coating on some parts of the lids and bottoms caused by flowing off of the lacquers having very low viscosity for dipping and pouring, and the porosity caused by mechanical stress of the empty and especially of the full can. Details as to their extent cannot be given, because the various formation of phosphate crystals and, therefore, the brittleness of the surface causes a very different behaviour of the cans in practice.

Effect of porosity.

The effect of the unvoidable porosity of a one layer lacquering can be accepted - from the point of view of the just demands which should be made to can materials - only in the case that, similar to tin-plate, a high corrosion resistance effect is produced by the inorganic surface protection. Schuster declares that the points of the zinc phosphate crystals are not completely covered by the lacquer coating, but that they cannot cause any corrosion in an electrochemical sense on account of their non-metal nature. This statement does not correspond with the practical results of the use of phosphatised cans The phosphate layer is

very easily soluble in acids and the pores of lacquer cause corrosion in a remarkable manner. With the stronger aggresive vegetables, such as carrots and celery and the like, the stability is limited in such a way that the preservation of the canned goods from crop to crop is questionable. The cans cannot be used, for acidified vegetables and fruits. (Number tables 3 and 4).

Table 3.

Average Stability of Important Vegetables and Fruits in phosphatised, dip-lacquered Cans.

Peas	months	18-24
Beans	"	15
Carrots	"	6
Celery	"	7
Plums	"	less than 1
Apple sauce	"	" " 1
Peas with potatoes and bacon	"	18-24
Carrots with potatoes and Pork	"	6-8

Table 4.

Iron Content of Important Vegetables and Fruits in phosphatised, dip-lacquered Cans.

Peas	after	18	months	mg/kg	50
Beans	"	18	"	"	160
Carrots	"	18	"	"	140
Celery	"	18	"	"	190
Plums	"	1	month	"	155
Apple sauce	"	1	"	"	120
Carrots with potatoes and bacon	"	18	months	"	105
Peas with potatoes and pork	"	18	"	"	58

C. The Cylinder-Primed, Spray-lacquered Can.

Process.

The body is manufactured by welding of cylinder-lacquered black iron, the bottom is punched of the same material and fastened The lower part of the can is then coated with a spray-lacquer. The manufacture of the lid is performed in the same way. The welding seam is coated by a special lacquering.

Causes of porosity.

The cylinder lacquering gives the base protection of the sheet iron For this priming coat the thickness of which is low for technical reasons, there exist all the sorts of porosity described with cans of cylinder lacquered material except the seam.

The elastical properties of the coating on sheet iron play an essential part for the porosity in this process. If a foliating of the priming coat occurs when the lids and bottoms are stamped or the bottom lacquering is lifted off, then a high porosity of the spray lacquering too is unavoidable. It faults occur in the priming coat causing the formation of free iron surfaces, the double layer system of base and spray lacquering is without any use. The combination of base and spray lacquering must be then considered as a one layer system, wherein as is explained in the phosphatising method, the spray lacquering being the only surface protection cannot fully neutralize the acid action of the canned goods.

Schuster compares the phosphate layer as a binding layer with the surface of sheet iron roughened by sand jet blower. He declares that by the phosphatised surface of sheet iron a better adhesive power is warranted than by the surface roughened by sand. But it must be ascertained in this connection that adhesive powers attained in the large scale production of ground-lacquered sheet iron are not inferior to that of phosphatised material, but that they surpass them as to elasticity, if phenol resin lacquers free of oil are used. From these statements which can be made by simple tests with correctly manufactured cylinder lacquered plates,or straps rolled in the hot or cold state, it must be concluded that besides roughening by sand or phosphatising the surface of sheet iron has been influenced by other means, not considered in the treatise of Schuster.

The parts of the cans mostly endangered by the porosity of ground and spray lacquering are the welded seam and the lid and bottom channels. With the seam obtained by lap welding, the cutting edge inside the can is the place where porosity must be expected. Porous parts of the can where iron might be dissolved, besides the welding seam, are obtained by insufficient covering by means of spray lacquering of the first coat of the bottom which is perhaps broken in chinks by forming or by breakage of the spray and ground coat when the lid is seamed on.

Effect of porosity.

The porosity of the surface protection obtained by this method is very small according the the present state of the technic. The author has often referred to the value of this process for the diminuation or the avoiding of porosity, in his experimental work begun in 1935 and has shown the advantages of cans produced in this way by extended tests. Accordingly, the time of stability for mixed canned goods, i.e. mixed foods containing meat, vegetables, legumes, cereals, etc., and for all vegetables was greater than a year. (Table No. 5).

T a b l e 5.

Stability of Mixed Foods and of Vegetables in spray lacquered Cans of Sheet Iron.

Peas	at	least	2	years
Beans	"	"	2	"
Carrots	"	"	2	"
Celery	"	"	2	"
Peas with potatoes and bacon	"	"	2	"
Carrots with potatoes and pork	"	"	2	"

The still existent porosity of these cans could not reduce, also in unfavorable climatic conditions (e.g., in a subtropical climate), the stability of the goods named above. Storage results sufficient for high claims have also been obtained, in large test series, with goods of high acidity, as tomatoes, acidified vegetables, marmalades, fruits. But the mass production of cans resistant to acids is questionable on account of the porosity in the endangered parts which cannot be avoided, principally in a large scale manufacture, (cp. picture 5), according to the experience made with tin plate.

T a b l e 6.

Experimentally Determined Stability of Acid Vegetables and Fruits in Spray-lacquered Cans of Black Iron.

Beets	months	8
Spice cucumbers	"	5
Pulp of tomatoes	"	13
Plums	"	10
Apple sauce	"	12
Bilberries	"	8

Table 7.

Iron Content of Important Vegetables and Fruits in Spray-lacquered Cans of Black Iron.

Peas	after 24 months		38 mg/kg	
Beans	"	24 "	42	"
Carrots	"	24 "	84	"
Celery	"	24 "	76	"
Plums	"	12 "	163	"
Apple sauce	"	12 "	119	"
Peas with potatoes and bacon	"	24 "	35	"
Carrots with potatoes and pork	"	24 "	71	"

In view of the great number of possible combinations involved in this method, a thorough suppression of porosity may be awaited in the near future. The key to the production of generally useful cans of sheet iron is to be seen in the absolute freedom of porosity of the organic protective coating. This may be also ascertained with the foil lined cans.

D. The Foil Lined Cans.

Process.

Sheet iron or straps are coated with a foil indifferent chemically and as to taste. The plates thus protected are worked up into bodies. The bottoms and lids are punched of the same material and attached.

Causes of porosity.

Theoretically, these cans should be absolutely free of pores, and this is indeed the case with an important percentage. Occuring porosity must be based on the fact, that the foil sheeting is not free of pores, or that the foil is mechanically damaged while being worked, or that the foil is cracked when lid and bottom are seamed especially in the case of insufficient elasticity; porosity chiefly is caused by breakage of the foil at the double seam which must be very strongly pressed in order to obtain a good tightness of the can.

Effect of porosity.

Cans with undamaged foil coating, i.e., a coating free of pores, are stable for a practically unlimited time, as far as it can be said today. But the smallest pores cause a rapid failing of such cans. (Effects based on dialysis are not considered here). There is no longer present an acid resistant layer able to neutralise or diminish corrosion if the liquid of the goods penetrates

the coating fast to acid. Lifting off of the foil and bulging the lid and bottom occurs by formation of hydrogen. The phenomena induced by porosity are similar to those as are observed with phosphatised and dip lacquered cans containing acid goods. The phosphate layer soluble in acid cannot prevent the corrosion by acid. Bladders are formed on extended parts or the coating is completely lifted off. Contrary of these drawbacks the method of lacquering in two layers has the advantage that corrosion is only possible on those spots where the pores of the second lacquering coincide with the pores of the ground coating. Furthermore, the resistance of the lacquer layers to acids is so high that the penetrating of acid below the coating is considerably slower than with the two other types of cans.

Conclusion.

1) The porosity of the coating of tin plate has a detrimental influence on cans only when their acid contents corrode both tin and iron or when they act as a strong corroding agent on iron.

2) Given an acid content as mentioned in 1, the porosity of lacquer coated tin plate may have the effect of rendering lacquered cans useless through pore corrosion or of destroying them in a much shorter time than ordinary tin cans.

3) Due to the nature of the electrolytical process and depending on the thickness of the tin coating, the porosity of the coating of electrolytically tinned sheet iron is greater than that of tin plate. The effects of the porosity as mentioned in §§ 1 and 2 as well the effects of the porosity of the lacquer coating are greater in this case. With the invention of "Bezidit" a plate has been found which has few pores and only a slight tin coating and which almost equals the durability of tin plate.

4) Due to mechanical damage caused in the process of production the porosity of the cylinder-(roll)lacquering on sheet iron is so great that this process must be considered inferior to the kinds of coating mentioned in §§ 5, 6 and 7.

5) The porosity of the coating obtained by phosphatising and dip lacquering of cans is considerably less than that of the coating mentioned in § 4. The phosphate coating is, however, not supposed to be able to offer resistance to organic acids. In view of present methods of production the dip lacquered coating forming only one layer which covers the phosphate layer is considered to be porous.

6) The porosity of the ground and spray lacquered coating is only slight, being a two layer system with after-treatment The porosity in this case has only local effects. The prospects of finding an organic coating entirely free of pores are considered to be good.

7) To avoid pores completely has so far been possible only with the foil lined cans. It cannot yet be predicted to what extent it will be possible in the future to reduce in large scale production the at present unbearably high percentage of foil lined cans with a porous coating. The pores in this kind of coating have a very detrimental influence on the durability of the cans.

APPENDIX III.

The Principles of Preservation with Elimination of Tin Plate.

By Dr. Eduard Nehring, Brunswick.

Everything is in a state of flux in times of war. In the substitute for tin plate used for manufacturing preserve cans, progress has been made in the past two years which brought about revolutionary changes.

To appreciate these changes and their importance to the preservation industries the development of the preserve tin should be traced back the years prior to 1914. The can material of the preservation industry exclusively placed on world's market was hot tinned black plate containing 30 - 60 g of tin per square meter on both sides. For many European and all non-European states this did not change in the years 1914 - 1918. The states of Central Europe, however, had to maintain the principles of preservation without application of tin plate in 1916 - 1919. The industries of these states did not allow the solving of this problem so important for hard-pressed nations. There was resistance to the problems of protecting the surface of black plate without application of tin and in general to manufacture of black plate cans.

Striving for solutions to these problems has led Germany to results without which the preservation without application of tin plate could not be conducted in Germany without interruption by war.

The introduction of cold-rolled strip steel as raw material for cans and the industrial first attempts for protecting the surface of black plate by electrolytic tin coating should be mentioned.

In the development of cold-rolling mills for manufacturing material for cans the German industry took its own

course which gave the rolling mill enhanced mobility for adapting themselves to the fluctuations of the market from 1919 to 1933. The narrow bands of a width of 127 mm, at which the band width corresponds with the altitude of the cans, were changed to bands of about 320 mm, at which the band width was adjusted to the circumference of the cans. The employment of strip mills with essentially greater widths which the USA exclusively installed with omission of the narrow band step was not decisive for solving the problem of the can free from tin. These heavy rolling stands merely confirm the application of cold-rolled material in many branches of industry preferred by reason of quality and economy.

Wnen the development of cold-rolled strip steel hot tinned in Germany shortly called white band, constantly increased cold tinning fell into Sleeping Beauty's slumber for more than a decade from which it was only awakened by creating the acid tinning electrolysis. Within a few years this equipment, so important for subsequent development, was put into technical mass production and developed to considerable capacities.

Within the sheet steel producing and processing industry a misalignment of the varnish equipment occured.

Hot tinned strip steel was especially adapted for fruit preserve cans as small-porous tin plate material with high surface properties. The necessity of varnishing these cans for some fruits, and the impossibility of erecting these plants in tinware factories in view of the size of furnaces for varnishing strip steel, led to the installation of varnish plants in the rolling mills the production of which was adapted to the capacities of producing strip steel. In this manner plants for producing strip steel were created, forming, by means of equipment for electrolysis and varnishes, the principles of any possible combinations for protecting the surface of black plate in band form.

This development restricted the rolling mills to the production of sheet steel which was adapted to the ever increasing improvement in the surface technique of steel proceeding from the strip steel side by inserting standard furnaces, electrolysis for sheet steel, and corresponding varnish equipment.

An instrument was created therewith by the steel producing industry offering many possibilities of combination.

Several years before the war the packing industry attempted to solve the problem of cans free from tin in a different manner.

The combined phosphatizing-dip-varnishing-process was applied in times of peace, although to a limited extent. By this process the quantity production of cans free from tin was made possible.

Completely new ways for the production of preserve cans were prepared by introducing aluminum into the packing industry. In a large scale test important knowledge was gained up to the outbreak of the war.

Varnishes poor in oil on the basis of artificial resin were being successfully tested at outbreak of the war; just as the packing material for preserve cans developed on the basis of plastics.

Excepting the extented preservation industries the total demand on can material was covered by tin plate. Since tin is one of the scarce metals of the European continent, it is not feasible to regard the protection of the black plate surface by tin as a satisfactory solution of the preserve can problem. The drawbacks of tin plate (cf. in preserving some sorts of fruits) are known. The instability of tin to certain chemicals customary in the preservation industry, such as nitrates, nitrites, sulfites, and metallic copper, was a difficulty of subordinate character which had no special importance in using this raw material for all possible filling goods.

The importance of this metal resides in the fact that it does not only exert mechanical protection, the effective value of which requires closing hermetically the influence of the filling goods from the instable metal, but represents a metal coating with physico-chemical action. The half-best-quality of tin plate, tinning with about 30 g per square meter on both sides usual for preserve cans, shows a porosity which was not to be tolerated for any mechanical surface protection. It would lead to an absorption of metal

by the contents and to a strain of the material. The fact that tin in conjunction with iron proves anodic,and, therefore, basic to the action of certain acids, especially fruit-acids, prevents considerable dissolution of iron in spite of the porosity of this surface protection. Moreover, tinning is a good external protection for preserve cans, although more problematical in its stability as internal protection.

Thus the unlimited application of tin plate even in times of highest technical advances in the years before the war is to be comprehended in spite of striving of all nations for abandoning the troublesome tropical tin basis. Opinions that tin be only a gliding agent and elastic ground for varnish but no anti-corrosive, or that tin plate would first be attacked by corrosion as soon as iron is laid bare at any place, cannot be proved by science or practice.

The work done by industries responsible for manufacturing preserved food in all European states, especially in Germany, cannot be better shown than by contrasting the results produced in practice with application of tin plate and the new raw materials. The conclusive force of another argumentation would be strongly lessened by the fact that even in the year 1942 tin plate was regarded by outsiders and experts a very desirable material for preserve cans.

The possibilities of preserving without application of tin plate are realised in practice by the following processes:

1) Substitution of iron for metals or raw materials more impervious to corrosion;
2) Utilization of the electro-chemical effect of iron-tin combination with reduction of the tin quantity hitherto generally regarded necessary;
3) Protection of iron by organic-chemical coatings with and without chemical or mechanical pre-treatment of iron.

When limited storage times or difficulties to be overcome are shown for the single sorts of cans and filling goods, it should be understood in such a manner that the striving for the problems shall be shown, but it must not be regarded a degradation of the raw material or a kind of cans.

For the substitution of iron by metals or raw materials impervious to corrosion two kinds of material are used in practice: aluminum and glass.

My arguments in 1939 about stability and demands on this raw material as well as the explicit indication that one of the most interesting developments in the preservation without tin plate is involved are verified in practice.

In the meantime the knowledge of the possibilities of applying this raw material are enlarged and have led to results which may be outlined as follows.

The stability of bright aluminum 99.5 %, without chemical or organic surface protection, depends to a higher extent on slight variations in the composition of the filling goods than is the case with tin plate. Changes in contents of common salt, natural differences of individual preserve goods, such as beans and peas, and differences of hydrogen ion concentration, may lead to reductions of storage times expected or predetermined by thorough experiments. This may be illustrated by the following example:

Bright aluminum - two years

Asparagus	H_2:	-	35	mg/Al/kg
Peas	H_2:	-	15	"
Beans	H_2:	+++	150	"
Carrots	H_2:	+++	130	"
Spinach	H_2:	+++	250	"
Milk	H_2:	++	50	"
Pork	H_2:	-	10	"
Blood-pudding	H_2:	+	45	"
Mushrooms 0.9 % salt	H_2:	+	50	"
Mushrooms 0.1 % salt	H_2:	-	25	"

Champignons preserved without additio.. of common salt are stable in bright cans for more than 2½ years without bombages. With common salt contents of about 0.9 % in the same storage time about 40 % show chemical bombages.

For vegetables the different corrosion effects of the individual kinds of vegetables and the absorption of aluminum occured after a storage of two years may best be seen from the table.

Similarly for meat. It is not feasible to say that meat and sausages can be preserved in bright cans. Rather, the storage time depends on the composition of the

filling goods. Meat dressings, especially sausage and the numerous special articles of this preservation industry, diverge from one another and in the single factories in such a manner, that wide variations of storage time result.

Even with milk according to pH-value and composition with occur.

For stability of bright aluminum to pickled fish, my experiences rank behind those of the research institutes Stavanger and Wesermuende. But they are practically identical with my arguments about the other important filling goods. Bright aluminum has proved true for distinct pickled fish in oil having little water, f.i. in Norway. The peculiarity of German pickled fish for the preparation of which - corresponding with the German taste - acid fancy sauces are used, does not admit the application of bright aluminum for this important field.

It is hardly necessary to mention that fruits cannot be preserved in unprotected aluminum.

The processes of chemical surface treatment, as eloxing and MBV- or EW-methods, are able to reduce this tendency to corrosion inherent in aluminum of a composition recognized as most favorable.

It is possible, however, to eliminate these difficulties and attain a high resistance to corrosion of this type of can, similar or equal to that of tin plate, by a spraying or dip lacquering method adapted to the material. Considering the narrow limits for the application of blank aluminum cans due to the natural influence of the material to be filled in or due to the additions usual and necessary for vegetable and meat when used for storages longer than one year, lacquering should be applied on principle.

By these means the corrosion problem of aluminum with regard to practically all kinds of material to be filled in may be considered as solved. Only for fruit preserves and fish sauces, I demand the necessary reservation as to mass production, considering the particular behaviour of this kind of preserves, although favorable results have been attained with testing preserves or strawberries. Since

the plate working industries have been adapted to this kind of after-lacquering, the most favorable preconditions for aluminum and for other materials still to be dealt with, are given.

According to my tests, the combined application of the method of chemical treatment of surfaces and lacquering is not necessary for the most important foods.

Technical journals and newspapers have dealt with the problem of unlimited applicability of aluminum for the preserving industry. The effective capacity and productivity of the preserving industries has been neglected in these works. The work of the Norwegians who helped to evade the mechanically unfavorable properties creating the escess pressure autoclave and using body and bottom ribbing, should be mentioned here. It is not possible, however, to transfer the experiences made with small packages and semi-mechanical working to the all-mechanical preserving industries with packages, as the vegetable preserves industry.

In order to avoid the decrease of the productivity inherent in processing aluminum cans, both producer and consumer of this kind of cans must concur. The vegetable preserves industry cannot renounce automatic supply of the cans and fill automatic sealing machines because of difficulties due to the material; if it does it must renounce its national economic task of storing during winter the large quantity of vegetables supplied in the pea and bean season.

The production of aluminum cans on a large scale should be cautiously preceded by the manufacture of small and middle packages before turning to the manufacture of big packages (1/1 cans). In this way the justified wishes of the consuming industries can be duely considered and false conclusions avoided.

Glass has contributed remarkably to relieve the chain of metallic materials. The standardized glasses and the crown caps have proved very suitable. Without any doubt the glass problem too is not yet completely settled.

Efforts to reduce the preserve glasses' weight without decrease of their resistance to breakage have been successfully initiated.

Regarding receptacles based upon black plate I may point to the explanations given in the introduction of this report dealing with the historical technical development from cold-rolled strip steel to plate and of the possibilities of its refinement. The group of materials to be used utilizing the electro-chemical effect of the iron-tin combination with large reduction of the iron-tin combination with large reduction of the tin quantity hitherto generally considered as becessary is represented by the black plates or black bands coated with tin by galvanization and, by an important product of spare tinning: Bezidit.

Whereas the fire tinning procedure only includes tinning degrees of about 25 g/m^2, galvanic tinning includes the range of 1 to 25 g/m^2. Tinning electrolysis is actually the best method of providing steel plates with an accurately determined tin coating. As compared with fire tinning it has the disadvantage that the tin coating is applied superficially to the steel, and that there does not exist the intense union by means of the interstrate of the iron-tin alloy. This interstrate, however, plays a very significant part on the resistance of tinned plates to corrosion. It facilitates working (as for instance soldering). Without an interstrate galvanic tinning with 2 to 12 g/m^2 has proved very favorable.

With fillings of small aggressivity as meat and peas - using unlacquered plates durabilities of 1½ to 2 years have been reached without any deterioration of the contents. By lacquering, the capability of being stored amounts to that of tin plate. With more aggressive fillings, as beans, spinach, cheese, especially those dissolving tin (spinach, carrots, beans) lacquering should always be applied. Durability of 2 years and more has been verified in all tests. For very aggressive fillings (fish in acid sauces, fruits) a storage time of one year can be had by application of spray lacquering. The lacquer types must be those used for

cylinder-spray lacquering of black plate. A single cylinder lacquering is not recommended for preserving extremely aggressive fillings. The resistance of spare-tinned black plate is considerably increased in the form of bezidit. If unlacquered black plate is used all vegetables may be stored for up to 2 years without any diminishing of their quality perceptible to the consumer. Even aggressive kinds of fruit such as morello cherries could be stored for $1^3/_4$ years in cans with single cylinder lacquering, without these cans being corroded or bulged out by chemical influences.

In all kinds of meat and vegetables and mild fruits there is a material to be disposed of with which by single cylinder lacquering effects were attained which correspond perfectly to those on tin plate. In comparison with tin plate there are no differences to be expected with regard to the action of very aggressive fillings upon spray lacquered cans. "Bezidit" blank has proved a valuable substitute for tin plate in the production of milk preserves. It has been used for practically the total milk production since 1940. As it is easily soldered it could be worked on the grooving-soldering aggregate of the Troyer-Fox type when the speed is reduced. The blank cans proved perfectly resistant during more than 12 months without deterioration of the contents.

With this kind of spare-tinning and the experiences with cylinder lacquering of black plate, particularly with spray lacquering, a great quantity of tin is saved.

Among the materials in which steel is merely protected on its surface by organic protecting agents the cans with tinned soldering joint hold a special position. They represent a combination of cylinder lacquering with soldering joint - electrolyses. This material has been of decisive importance to the German preserving industry as it made it possible to go on preserving vegetables and meat preparations. This material has been outrun by the two new welded can types however.

The fact that it became possible to work black plate on all soldering aggregates existing in the tinware industry by

means of tinning the soldering joint cannot be over emphasized with regard to the last 2 years of war. The durabilities of about 9 months for vegetables and about 12 months for meat and meat preparations attained with the cans were sufficient to secure the supply of vegetables in the months during which they are not available.

The damages on the superficial protection layer necessarily caused by the cylinder lacquering process, which reduce the durability of goods preserved in this type of can made it necessary to limit the storage time to between 6 and 12 months depending on the kind of the fillings. The rule of thumb which prescribes chosing storage time corresponding to about the half of the storage possibilities determined by tests has proved satisfactory for mass production.

It was evident that this package material only could represent a transitory solution. A fundamental change was to be expected from methods which promised superficial protection of the steel as perfect as it could be attained by technical means.

Two processes have proved suitable for mass production:
the phosphatizing-dip-lacquering procedure and the spray-lacquering of the cylinder lacquered black cans.

Phosphatizing and the subsequent dip lacquering has been described in inland and foreign journals often and accurately. As I already mentioned, this kind had found entrance into household preserving before the war.

The possibility of preserving with this type of can must consider the welding method as being an important factor in the fundamental development of tin free after-treated cans. Without the creation of automatic welding aggregates there could not have been any thoughts of supplying the preserving industry with valuable black plate cans.

Two characteristics are typical for this can type:

1) Similar to aluminum, a chemical treatment of the surface in order to protect the cans against corrosion has been applied for the first time.

c) Based upon the technical application of this method, dip lacquering or "pouring over" lacquering is used.

The wet treatment in the so-called Bonder method is distinguished from the known chemical treatment of the surface of aluminum by the fact that the phosphatized layer by itself does not permit any protection against corrosion by the influence of the fillings. These kinds of layers are sensitive to corrosion, especially when caused by organic acids.

Accordingly, the value of a treatment of the surface is not found in an independant protective action of the phosphate layer. But two effects are attained.

A protection of the outsides of the cans against atomspheric influences (rust prevention); a good fastening of the lacquer to the surface; and security of lacquer from being detached by chemical or mechanical influences.

In Contrast to this, the surfaces become rather brittle by phosphatizing, which requires the anti-corrosive lacquerings to be made very elastic. In the case of a great number of lacquer types this elasticity is combined with a weakening of the stability to acids. Hence it follows that cans of this type which have proved very suitable for a number of vegetables and meat preparations, cannot be used for sour fillings.

At present we are in a stage of development which makes it possible that the fastness to acids of the so-called "Bonder"-cans will essentially be enhanced. An especially important feature of this process seems to be that it tries to get the roughening of the plate not only by mechanical but also by chemical means. It is without any doubt that the favorable, mechanical or chemical, treatment of the steel surface has a great influence on the quality of lacquering.

It is to be further considered that in this way two possibilities might be realized, i.e. to develop a chemical surface processing of sheet steel not only protecting it against rust but also improving its resistance to acid, and to attain at the same time an improved adhesive power of the lacquering owing to the roughening caused thereby.

In such cans, meats can be stored for about $1\frac{1}{2}$ to 2 years, while the usual vegetables such as peas or beans etc. can be stored for 12 months without difficulty. Also when storing cheese on a large scale the cans have proved to be useful for one year and even longer time. For the other goods to be canned, especially those of acid character, great improvements are going to be developed by using the experiences made in the operations on a large scale. Thus it may be stated, that for two of the most important types of preserving, i.e., of meats and vegetables, the Bonder-process has made it possible to preserve without the use of tin plate. The second type of can which perhaps may warrant a general and far-reaching preserving practice is the inside-sprayed can.

Numerous details about the production of these cans have already been published, so that it seems to be sufficient to report on the applicability and reliability only.

A product of high quality can be produced only from a starting material which has been satisfactorily prepared by cylinder-lacquering the surface of the material previously being mechanically treated in order to warrant a satisfactory adhering of the lacquer. When making the cans out of this material by a welding operation, two disadvantages are to be overcome.

1) The welding seam is to be secured against corroding influences. As it has become free from lacquer, an after-lacquering is necessary.

2) The damages of the ground lacquer caused by the producing process are to be covered by means of spray lacquering.

As the surface does not become brittle by the mechanical roughening, the choice of suitable types of lacquers is easier than in the Bonder process with its high requirements. Regarding the present state of development it is obvious that the fastness to acids of such cans is to be regarded as the most favorable to the preserving.

As the use on a large scale began only 9 months ago, statistics are not yet available.

Based on pre-war experiences made with lacquer types containing great quantities of oil, the value of spray lacquering can clearly be demonstrated, for instance, with a corrosive vegetable such as spinach.

Hydrogen bombages:

	Months	roll-lacquering	Spray-lacquering
Spinach	8	30 %	0
"	11	50 %	0
"	14	85 %	0
"	17	100 %	0
"	21	100 %	0

Contents of iron after two years.

	Roll-lacquering	Spray-lacquering
Carrots	315 mg/kg	140 mg/kg
Spinach	235 "	150 "
Beans	200 "	120 "
Kohlrabi	160 "	115 "

The applicability may be illustrated by the following incubating values obtained at 50° with corrosive goods, the values being compared with those obtained with tin plate.

Stability at 50°C.

	Plums	Beans
Tin plate	60 days	70 days
Can with soldered edge	4 "	10 "
Sprayed can (1939)	10 "	20 "
Sprayed can (1941)	45 "	70 "
Bonder can		40 "

The experiments made on a large scale with cherries, apple sance and plums, running at present for more than 8 months at 10 to 15°C. of storage temperature, have not shown any chemical bombages up to now. Furthermore, experiments made with tomato pulp at an incubation temperature of 50°C. running already 30 days, show no bombages.

As the spraying process is not applied to both sides of the can as it is the case with the dip-lacquering method, the protection against rust had to be secured by a simple roll lacquering. The protection against rust may favorably be secured by electrolytically outside - coating with zinc, the can assuming at the same time the appearance of tin plate.

According to preliminary experiments and to the satisfactory behaviour of the cans, it can be assumed, that the cans preserve meat for two years and more and all kinds of vegetables for 12 months and essentially more. With the progressive development of the types of lacquer and the process of lacquering it will be possible to preserve for one year weakly acid goods such as fishes in weakly acid sauces and weakly acid vegetables.

The previous experiments with fishes in weakly acid sauces such as tomato or similar fancy sauces have run for more than 6 months and show neither corrosive parts on the inside walls nor any chemical bombages. The process has proved to satisfactorily preserve cheese for one year and, after preserving milk for 10 months, the experts say that a damaging of the contents by the can walls could not be observed.

In the foregoing I have shown the successes obtained in the preserving of all important goods within pure black plate cans. These successes are similar to those obtained with tin plate. They can be fairly valued by the preserving industry only when considering that the work, not mentioning the extensive preliminary experiments, was done within two years. There can be no doubt that, considering the extensive preliminary experiments, was done within two years. There can be no doubt that, considering the extensive work done by different people in developing the black plate can, further important developments are to be expected.

The results obtained would not have been possible in the industry of artificial resins and lacquers had not corresponded to the requirements of the consuming industry regarding the preserving process and to the technical requirements of the can producing and rolling mill industry.

The development follows:

The lacquers used in peace time for preparing tin plates were pure oil varnishes, the resinous parts of which were essentially fossil natural resins, such as amber or copal, and the oily parts of which were bodied linseed oil and woodtar oil. Before the war the oil varnishes

were replaced by alkyd resin varnishes in order to save drying oils. By combining the alkyd resins with oil varnishes on the base of wood-tar, lacquers were obtained yielding films of practically the same resistance as that of the old pure oil varnishes. These types of lacquers being well suited when applied to tin plates were found to have not the same suitability when applying them to black plate. Their adhesiveness to black plate did not wholly satisfy. Furthermore, these lacquers became brittle on account of the sterilization process performed in water. The use of the new artificial resins in the process of lacquering black plate was not only caused by the desire to save oil but also by the possibility found in working the problem, to get more favorable results on the new base than on the old way of using oil varnishes.

In the experiments of 1937 it had been found that lacquers be made from plasticized phenolic resins (capable of being hardened with addition of drying alkyd resins as softening agent) without the tendency of becoming brittle when applied to black plate and possessing the stability required from a good can inside lacquer. The plasticized phenolic resins capable of being hardened represent resols which, in the course of their production, have been treated with monoalcohols, thus becoming soluble in hydrocarbons and miscible with ester-like softening agents, such as, dyring oils. When combining these converted resols with unsaturated softening agents, such as some natural oils, or when producing resins and especially when hardening the lacquer films, a reaction sets in between the resol and the oil causing the formation of a chroman ring whereby a new uniform homogeneous plasticized resin is produced. In this process a separation of the hardened phenolic resin from the softening agent cannot take place, which however may occur when the usual, unconverted resols are combined with softening agents and burnt in. The alkyd resins in the converted form of their oil compounds are likewise suited as components for plasticizing the resols treated with mono alcohols. In this process the reaction mentioned above may likewise set in between the phenol resols and the unsaturated fatty acid radicals of the alkyd resin.

The oil used in preparing the lacquers was a natural oil. Later they succeeded in using synthetic fatty acids and thus to prepare the lacquers without use of any natural bodies. By means of such lacquers the main portion of the black plate cans produced in the years 1940 and 1941 has been lacquered. The experiences made with lacquers in the cylinder-lacquering process have completely reached the expectations which could be made as to the surface protection. In the mean time the combined cylinder spray lacquering and the "Bonder" lacquering have developed into another direction. Lacquers have been produced which possess an elasticity sufficient for all purposes and which surpass the types mentioned above by a multiple of their resistance to acids, salts, etc., without containing any natural resins or natural or synthetic fatty acids. There have been developed deep drawing lacquers on the base of artificial resins, to be used in the cylinder lacquering process without a subsequent spray or dip lacquering being necessary. These lacquers made it possible to preserve for 6 to 12 months the German and Norwegian drarts, which results both from own observations and from those of engineer Mathieson at Stavanger.

The natural rubber contained in the tightening material could be replaced by plastics without any disturbances of the industry of preserves.

The German preserves industry is highly interested in the developments of preserving processes without use of tin plate made in other countries, namely the production of new types of natural lacquers in Italy, the production of tin-free meat, fish and vegetable cans in France, and the experiments made with aluminum in Norway.

I hope that this report supports the principles of preserving practically all goods without using tin plate; and that the aluminum can, the galvanically tinned can, the Bonder and spraying can represent containers which allow each kind of preserving.

APPENDIX IV.

Recipes for Can Lacquers and Compounds.

Hermann Wiederhold, Hilden.

Enamels for Sila and Sila Special Cans.

Enamels used for these two types of cans ar disclosed in the attached recipes. Application techniques and operating directions are identical with those supplied by the Schmalbach Company, one of the principal users of the Wiederhold lacquers.

Recipes:

Base Coat 1367 (Regular, 27-3-44)

Synthetic resin HW (Albert, Wiesbaden)	48.00
" " W 60 % (I.G. Ludwigshafen)	1.10
Ethylene glycol	50.90
	100.00

Side Seam Coat (Regular, 25-11-44) for Brush Application - No. 35 840/30

Synthetic resin HW	29.80
" " W 60 %	0.60
Ethylene glycol	48.72
Butanol	20.88
	100.00

Side Seam Coat (Regular, 25-11-44) for Spray Application No. 35 840/40

Synthetic resin HW	39.74
" " W 60 %	0.80
Butyl acetate	5.29
Ethylene glycol	54.17
	100.00

Side Seam Coat (Regular - New) for Roll Application - No. 35 840/50

Synthetic resin HW	49.67
" " W 60 %	1.00
Ethylene glycol	49.33
	100.00

Spray Lacquer 1377 (Regular, 27-3-44)

Synthetic resin HW	25.34
" " W 60 %	3.52
Alcohol	36.33
Ethyl acetate	32.44
Ethylene glycol	2.37
	100.00

Recipes or Formulas for Sila Special Cans - System 3.

Base Coat 1367. Same as listed above.

Side Seam Coat A 5650/7.

Synthetic resin HW	23.21
" " W 60 %	5.06
Butoxyl	18.98
Acronal 117 40 % (I.G. Ludwigshafen)	12.66
Butoxyl	18.99
Silicon carbide	21.00
	99.90

Middle Coat A 5620.

Vinoflex PC 820 (I.G. Bitterfeld)	12.12
Butoxyl	51.10
Alcohol	14.54
Synthetic resin HW	4.24
Ethyl acetate	18.00
	100.00

Top Coat A 5329.

Acronal 2500 (I.G. Ludwigshafen)	75.25
Ammonia (91°)	0.75
Silcar (Silicon carbide)	15.00
Titanium dioxide	15.00
	106.00

Consumption or Use.

Lacquer	Coating	Baking Temp. °C	Baking Time Min.
1367	plus minus 4 g	180/200	12/15
A 5650/7	very thick	200 (180/200)	1 5
A 5620	12 - 14 g	180/200	6/12
A 5329	18 - 22 g	180/200	6/12

Wiedolastic Compound N 50 697.

Rohagit S HV 5 % (Röhm + Haas)	8.160
Clay	23.860
Titan (Titanium) 100 %	3.240
Acronal 450 D (I.G. Ludwigshafen)	42.560
Plextol BS 40 % (Röhm + Haas)	21.265
Ammonia (91°)	0.620
Formaldehyde	0.295
	100.000

APPENDIX V.

Lacquer Operating Directions of the J.A. Schmalbach Company, Braunschweig.

Sila Can Lacquer Specifications.

Base Coat 1367.

Viscosity - 35-60 seconds at 20° in DIN 53 211 viscosimeter with 4 mm orifice.

Dry solids - 43-1 per cent as determined by drying a 2 gram sample in a 50 mm diameter tin dish at 210°C for 30 minutes.

Flash point - over 21°C in Abel-Ponsky apparatus.

Side Seam Lacquer N 35 840/30 for Brush Application.

Viscosity 14 plus minus 1 second in DIN equipment at 20°C with 4 mm orifice.

Dry solids - 26,5 plus minus 1 per cent.

Side Seam Lacquer N 35 840/40 for Spray Application.

Viscosity 29 plus minus 2 seconds at 20°C in DIN with 2 mm orifice.

Dry solids 35 plus minus 2 per cent.

Side Seam Lacquer N 35 840/50 for Roll Application

Viscosity - 70 plus minus 10 seconds in DIN at 20°C, 2 mm orifice.

Dry solids 43,5 plus minus 3 per cent.

Flash point - same as Base Coat 1367.

Spray Lacquer 1377.

Viscosity - in DIN at 20°C 12 plus minus 1 second, 4 mm orifice

with 2 mm orifice 58 plus minus 8 seconds

in Hoppler 10 plus minus 6 cp.

Dry solids - under 21°C in Abel or Marcousson

Operating Directions for Sila Lacquers.

Base Coat 1367.

Drying temperature - 180°C
" time - about 12 minutes
Application - 4 ± 1 grams (dry) per sq.m. for inner and outer use.

Side Seam Lacquers 35 840 30, 40, or 50.

Drying temperature - 180°C
" time - about 5 minutes
Application - dependent on method of application.

Spray Lacquer 1377.

Drying temperature - for cans, 21-22°C, for ends, same.
" time - for cans 14-16 minutes, for ends, same.
Application - for cans, inside 6 ± 1 g per sq.m.
for ends, inside 6 ± 1 g per sq.m.
for cans, total 0.3 to 0.35 g (Dry).
for ends, total 65 ± 10 mg. (Dry).

Tolerance of 10 ± 2 g. sq.m. allowed on combined application of base and spray coats.

Compound Application.

Specifications

Viscosity - 15 to 21 seconds at 20°C in Ford cup with 8 mm orifice.

Dry solids - about 49 to 53 per cent.

Application.

Applied at 0.8 to 1.8 atmospheres through spray or liner nozzle of 0.1 - 0.8 mm size.

Drying time - 12 - 15 minutes.

Drying temperature - 110 - 120°C.

Final Can Specifications.

For Sila cans, the following weights have been listed for various can parts expressed as dry lacquer or as compound:

Inside bodies - 100 mg per sq. meter.
Inside Bottoms - 120 " " " "
Inside packers
ends - 60 - 80 mg per sq. meter.
Total weight of lacquer per can - 300 mg.
" " inside and outside side seam stripes - 30 mg.
Compound lining weight (dry) - 220 - 240 mg. (per 99 mm end).

Control of Final Product - Rapid Tests.

A series of rapid tests have been set up for Sila cans as follows:

1) Appearance: - Evenness of coating and absence of blisters uniformity of color. Adequacy or completeness of side seam stripes.

2) Can sealing:- Resistance without leaks to 2.5 atmospheres air pressure.

3) Porosity: - 10 second current flow under 24 volts (Duffek) must fall between 0.4 to 0.7 amperes.

4) Lacquer coating: - Total spray and base coat must fall between 8 - 12 g. per sq.m. This test is made by boiling in NaOH. Sections of the can may be cut out for coating weights on specific portions.

5) Taste test: - Made on water sealed in the cans and processed 30 min. at 121°C. "The taste should not be too pronounced of lacquer, or bitter or medicinal".

6) Corrosion test: - Made by processing 1 per cent acetic acid in the sealed can for 30 min at 121°C. No corrosion, lifting of lacquer or blistering must be present.

7) Elasticity test: - Made by use of the Erichsen 20 mm ball cup test. A 5 mm penetration must be made without hair lines or fracture on the enamel.

8) Cover testing: - Completeness of coating, uniformity, evenness of compound and weight of compound (230 - 240 mg.).

APPENDIX VI.

A Report

on the Testing of Aluminum Cans manufactured by the United German Metal Works, Inc., filled with various Meat Products packed by The Hans Bar Company, Uttenreuth.

The following personnel participated in this test under the auspices of the German Meat Packing Industries Association:

Hr. Taubmann representing Dr. Lindig of the Production Division, Meat Industries, Berlin.
Hr. Bocker of the German Bureau for Packaging.
Hr. Gerster, Vereinigte Deutsche Metallwerke.
Hr. Forster representing the Hans Bar Co., Uttenreuth.
Prof. Kallert, Grau, Rievek and Gustine of the German Meat Packing Industries Institute.

The cutting tests were made on canned meats packed in aluminum cans, namely fifteen samples from the Hans Bar Co. pack of June 15, 1942. The products packed consisted of beef, pork, corned beef, liver sausage, and blood sausage. These products were packed in 850 gram and 400 gram aluminum cans which had been treated specifically as follows:

1) Plain or unlacquered aluminum cans.
2) Single coated " " .
3) Double " " " .
4) Plain EW treated aluminum cans.
5) Coated EW treated cans.

These various canned meats were stored in the cellar of the Institute for protection against bombing from 25. Oktober 43 to 30. Jan. 44. At this date the service facilities of the Institute were damaged by bombs. The greater part of these canned meats were removed safely from the burning building, however, and stored at the Berlin Military Building until February when they were again removed to Kulmbach. Here they were stored at 0°C. until the test was made. Transportation of these cans under rather difficult conditions did not result in any unusual deformations.

Canned beef in natural juice.

In general appearance, there was no discernible difference between the individual cans. Certain cans had a yellowish-white deposit. The meat had been cut into medium sized pieces which had a brownish-red color which in part tended toward a grayish shade and in part to ward a rose shade. In all cases, the meat could be cut easily and had a clean and somewhat aromatic odor. The taste was also good and with proper salting the meat was tender.

The only significant differences were noted in the degree of aromatic bouquet. The plain and lacquered and EW treated can contents were judged fully aromatic while the plain EW treated cans and the single coated cans were weakly aromatic and somewhat talc-like. The last two were classed as very satisfactory. The tests were all blind tests and an effort was made to distinguish any metallic flavor. No such taste influences were detected and this possible objection ruled out although the unlacquered cans showed slight corrosion while the others showed none.

Pork in natural juice.

In pork products the general appearance of the various containers showed no distinguishable difference. In all cans some mineral and fat precipitate of a white color was noted The meat consisted of small to medium pieces of a grayish-rose color and was well marbled. The meat could be cut well and was tender. It had a clean and aromatic odor. Only in one case a slight tendency towards a metallic flavor was reported by the taste panel members. This was not considered significant. The containers themselves were not corroded or changed preceptibly. The conclusion was that pork can be packed in aluminum cans and stored for 2'/ years without undesirable effects.

Corned beef.

The general appearance, flavor and all-round characteristics of the meats in the variously treated containers was identical. The corned beef contents had deposited very little tallow. The pieces were medium in size and reddish in color and the juice was of a gray-rose color. The meat could be cut easily and possessed a clean aromatic aroma and taste. Likewise the product was salted and spiced to a good taste and was tender and juicy. All containers can be recommended for this use. No corrosion was observed in any of the containers.

Liver sausage.

In the case of liver sausage a greater difference was observed as the product in plain cans had developed an undesirable fermented odor. The product was, therefore, classed as spoiled. It must be stated, however, that the cans were heavily dended and consequently the top seam was disturbed. This caused the spoilage.

A later examination of the plain cans containing liver sausage resulted in a completely satisfactory verdict. These cans had not been dented. The sausage had a gray-rose color and clean odor and taste. It was salted to good taste, spiced rather heavily and had a desirable liver flavor. No corrosion of containers was evident.

Examination of additional containers showed no differences. The sausage mass showed some yellowish-white fat separation. The color was gray-rose, taste typically liver-like, and the product cut and spread satisfactorily. In taste, the sausages from the EW cans were considered best while the sausage in the single and double coated cans had a less flavorful and flatter taste. The fatty content here had a slightly old taste. The sausage in both the EW and in the cans just described had been salted and spiced identically when packed. The panel, however, classed the single and double coated can samples as good. Further tests were made in single coated packages because of the fear that the container itself might be responsible for the fermented odor. These showed that the aluminum cans did not require lacquer to protect taste degeneration.

Blood sausage.

Here all the variously treated aluminum cans showed no difference in the blood sausages as to general characteristics. The sausage had a bright brownish-red color, cut and spread easily and was spiced evenly. The odor and taste were clean but the sausage was not salted or spiced heavily enough. Lack of salt and spicing, however, would have revealed taste degeneration more obviously if the alumin cans had such an effect. No such taste deficiencies were noted. The uncoated cans did have a grayish-black film deposit. The others were unchanged. No undesirable effects were noted, however, on the blood sausage itself when packed in aluminum containers.

S u m m a r y .

After packing and storing these meat products for over two years in aluminum containers and after repeated transportation under unusual conditions, the contents were judged to be satisfactory in quality and to have suffered no particular changes. This conclusion applies also to the plain cans in which despite some corrosion, as in the case of blood sausage, the contents were not affected. The quality of these canned meat was generally so satisfactory that no undesirable effects could be charged to the aluminum containers. This test will be repeated as long as supplies of the above remain on hand and the text cutting test is planned for the spring or summer of 1945

APPENDIX VII.

Cans for the Wehrmacht.

Translation of a statement issued by the German High Command (undated issued probably between 1939 and 1941).

The shortage of tin in Germany and the need for a great quantity of canned food by the Army directed the attention of OKH (the German High Command) to container standards. Several methods had been developed for the manufacture of cans without the use of tin and OKH gave further aid to the industry by allocating large supplies of black plate. The prewar developments by the German can manufacturers with close cooperation from the authorities assured the German Army in adequate supply despite the tin shortage. The introduction of margin tinned, roll lacquered black plate and the fact that currently operating can making machinery could produce containers for these sheets was acknowledged by OKH as the assurance that the troops would have adequate rations. Since the start of the war OKH had been concerned with corrosion-resisting containers which would have a longer storage life than the conventional tin can and which did not require tin.

Black iron plate remained as the basis for all metal food containers as other metals could not be spared for this purpose. Consequently, OKH specified this choice in preparing a set of standards to govern food container manufacture. These are as follows:

1) Production of basic plate for cans must not involve the use of imported metals.

2) Prevention of corrosion in black iron plate must be achieved through the use of materials produced within Germany whether such materials be metals or nonmetals.

3) The same limitations just outlined above will apply to the sealing material (compound).

4) Finished cans must be hermetically tight and should withstand an average internal pressure of 2.5 atmospheres and must pass a minimum pressure of 2 atmospheres as they come off the lines.

5) The lacquer or other means of assuring protection against corrosion must withstand sterilization procedures and must preserve sterility, flavor, color and taste of the major foods (meats, vegetables, mixed foods) for a minimum of 1½ years.

6) Externally, the cans must resist rust under ordinary storage conditions equally as well as cans made from tin plate.

To meet the specifications outlined above in No. 1 and 4 the following two procedures were well known in the industry:

1) The welding process.
2) The seaming procedure.

Welded cans required no further basic mechanical treatment and met the standard stipulated. With respect to seamed cans only the fully automatic double seaming procedure had met the requirement satisfactorily. Single or semi-automatic procedures had not produced the expected or satisfactory quality. Seaming procedures or other manufacturing methods which showed promise were supported with material allocations by OKH as a means of encouraging long range improvements. However, is was expected that all manufacturing techniques must not only be planned to meet OKH standards but must encompass fully automatic procedures to save manpower.

In reference to No. 2 of the OKH standards previously outlined, the development of special lacquers is considered a satisfactory answer. OKH, however, expressed great interest in further improvement in the inside lacquer coatings both from the angle of raw material conservation and the longer life of the product.

No. 3 of the OKH standards is met by the allocation and use of plastic base lacquers.

No. 5 of the OKH list requires a secondary treatment of all containers to assure a proper preservation of major foods and to extend the life of the black plate containers.

Two completely automatic procedures for this purpose have beem developed.

1) Phosphate-immersion procedure (Bonderizing).
2) Seam and spray lacquering.

OKH considers these processes to be of equal importance and to give equally satisfactory results as based upon earlier tests.

Up to the time of this report OKH had allocated 1,100 tons of black plate to the can industry for development purposes. OKH had relied upon sound competitive principles among manufacturers to produce the best containers with minimum utilization of critical materials. However, the anticipated conservation of lacquer materials, which also had become more critical, was not achieved. Consequently, OKH reduced allocations of black plate for bonderizing developments, apparently because additional scarce chemicals were required there and the plastic base for lacquers and the diluent were not conserved despite bonderizing.

OKH subsequently classified the development of double seaming and spray lacquering as most urgent in can production. Black plate allocations for further bonderizing developments were expected to be resumed fully when the material situation permitted and when sufficient progress had been shown with materials allocated previously.

Any allocations of black plate for immersion or spray lacquering and baking on the film by semi-automatic or hand processes would be given only to fill emergency needs. The manpower drain and currently unsatisfactory performance of containers thus made conflicted with the general operating principles laid down by OKH.

For Bonderizing and immersion lacquering, as far as blank black plate treatment is used, all procedures of pretreatment of black plate (cleaning, bonderizing) are already prescribed.

For spray lacquering operations, OKH required that all black plate be roller lacquered as per previous OKH stipulations. Covers, bodies and bottoms are all included in this requirement.

Referring to request 6, the Bonderizing process results in a good rust proof outside protection. Rust prevention of non-phosphated cans should be increased by using good aluminum lacquer or by tin plating external surfaces electrolytically.

OKH supports in the interest of industry those processes which have an extensive use for different fundamental materials (aluminum, aluminum plated black plate, white plate, and electrolytically tinned). These processes comprise:

a) The welding process which is being technically further developed and which makes possible the use of practically all fundamental materials.

b) The seaming process, which affords from a technical point of view the universal use of basic German made raw materials.

c) The immersion and spray lacquering, which despite its relationship to use of basic materials must extend the storage life of containers and contents substahtially.

OKH will sponsor, along with other German agencies interested in these problems, the expansion and use of the best manufacturing methods with a thought to their use after the war as well as during the emergency.

With reference to the use of aluminum, OKH was especially interested in four styles of food containers.

1) Collapsable tubes.
2) 200 gram cans.
3) 400 gram cans.
4) Cans for packing fish.

Tubes were considered very satisfactory when made from aluminum. The fish containers were considered particularly urgent by OKH. Recommendations were made likewise by OKH that the strength and resistance to pressure be improved in aluminum cans by increasing size of plate. Also, resistance to corrosion through the effects of the foods within the can must be cut down by lacquering these aluminum cans. Changes in sizes and shapes were also suggested to increase strength.

OKH considered it important to make its requirements for Army food cans known definitely to all manufacturers and to extend the qualifying note that the exact line of research and development could not be predicted but must remain elastic because of changes in the supply situation on German made and imported raw materials.

APPENDIX VIII.

Test of Packing Materials and Packings for frozen Foods.

By G. Kaess.

Institute for Food Research, Munchen, Dir. Dr. R. Heiss. Second Report.

(Translated from a Paper Appearing in der Papier-Fabrikant, Sept. 1943).

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It is not only necessary to have sufficiently low temperatures for preserving the quality of frozen foods, but the food must also be protected from evaporating water vapor from the influence of atmospheric oxygen and absorption and dissorption of odorous substances. This protection is done by packing, which must be resistant to the influences of the frozen goods (fruit acids, fat) and also must not change them detrimently by giving off undesired odors or physiologically harmful substances. Furthermore, the material should not lose the required qualities in lower temperatures and should also have stability. The package must be easily closed (if possible by heat), resistant against moisture and liquids, especially before being frozen and after thawing. The knowledge of the different properties of packings is of the greatest importance for construction of freezing packings and makes it possible to save valuable materials, especially in a different raw material situation.

1) Permeability to water vapor.

Losses by evaporation not only cause a loss in quantity, but also, if the process has gone far enough, cause a change in looks and taste. The latter can be prevented, if the losses in weight can be kept small enough so that the freezer burn does not show. Packing materials with little permeability to water vapor are of fundamental importance for packing of frozen goods, and special care must be taken in measuring the permeability to water vapor of packings for frozen goods. In order to get a good comparison, it was necessary to follow the suppositions given below:

a) knowledge of the permeability to water vapor of the necessary packing materials (papers, cartons, foils, etc.) measured by a quick laboratory method.

b) knowledge of the limits of the losses in weight, at which the frozen goods are still undamaged in their quality.

c) Degree of the permeability to water vapor of packing materials of the completed package under ordinary circumstances.

d) Relation between the laboratory findings and the values of permeability to water vapor received under practical conditions in the frèezing room.

a) Laboratory tests of the permeability to water vapor.

Tests on the permeability to water vapor have been done on more than 150 packing materials, which have come directly from the industry, and through the agency of the Reichs Department for Packing Materials, Berlin, the first results of which have been previously published. For determining the permeability to water vapor the instructions proposed by Wolodkewitsch were followed.

Because there are no generally accepted relationships between the permeability of water vapor and partial steam pressure as well as of the temperatures for packing materials, test conditions have been chosen according to the conditions as they are known in practice. In accordance with the storage of frozen goods, a temperature of -15^0 was maintained. Measurements made at $+20^0$ were supposed to give a criterion for industries not able to work at -15^0, at which places only local values of room temperatures are possible for packaging materials for frozen goods. On one side of the packing material is a relative humidity of 70 % (at -15^0 at $+20^0$ a relative humidity of 65 %). On the other side the relative humidity is about 100 % (water in contact with the packing material) or under the influence of 97 % water vapor, by using saturated potassium sulphate solution. The filter papers were wetted, when held 1.5 mm from the tested packing material. By choosing a 97 % atmospheric moisture, condensation of water on the material to be tested was avoided, because the temperature was kept exactly constant, so that only the steam phase acts. $CaCl_2$ solution was formerly used, which had about the same partial vapor tension, but had the disadvantage that the relative moisture decreases above $CaCl_2$ (to 90 %) which causes inexact results. To provide local fluctuations of

the air constitution in the testing apparatus and to speed up the evaporation, an air speed of 2 m/sec. was maintained. The medium values of at least 6 singles measurements have been used for determining permeability to water vapor. For each single measurement 4 - 6 determinations of weight were made; these were applied in relation to the time. The water vapor diffusion through the foils per time and level unit was calculated of the linear part of the curve. A selection of examples on permeability to water vapor is shown in table 1.

Because of the diffusion number it can not be expected that the permeability to water vapor of the different packing materials at -15^0 is in ratio to the values obtained at $+20^0$. The values obtained at -15^0 were about 10 to 80 times smaller than at 20^0. Tressler and Evers compared viscose foils, impregnated parchment and cellulose paper, and obtained at -14.5^0, values which had to be multiplied by a factor of 1.3 to 65 to find the result for $+21.1^0$. It was peculiar with some packing materials that the loss of permeability to water vapor was very small; in decreasing the temperature from $+20^0$ to -15^0 (e g. foil lined paper, lacquered imitation parchment) although the water vapor tension decreases nearly to 13 of the value at $+20^0$. This can only be explained by the great variation of permeability to water vapor at different places of the packing material, which are caused by the different manners of construction and the possibility of mistakes. Because it is improbable that the diffusion number increases, it is only possible that during the freezing procedure a mechanical exchange in the lacquer or lining shows up. This effect is similar to an enlargement of the evaporating surface, and so causes the considerably high values of water vapor diffusion. During storage the packing materials are affected partly by water vapor (the packing paper) and partly by the frozen liquid (inner sack, carton of the box, etc.). It is very suitable to arrange for measurements with a relative humidity of 100 % of one side, because the water content of frozen goods is generally very high (75 - 96 %) and the atmospheric moisture above it is nearly in all cases between 97 and 99.5 %. The humidity on the other side of the packing material should

not be too far off the usual moisture in freezing rooms (60 - 90 %), because of its dependence on the diffusion number of the medium atmospheric moisture.

It is well known, that the water vapor diffusion of any packing materials is much higher under the influence of water or ice than under influence of water vapor. This concerns papers and foils, in which the permeability to water particles increases because of capillary swelling and osmotic action, and in which the diffusion law is not unconditionally valid. The "v. Schröder-effect" does not appear if a gel is exposed to the water vapor a long time under exactly constant test conditions. But these hypotheses do not agree with the water vapor diffusion through packing materials as they are usually used for measurements of permeability to water vapor. A number of makremoleculat plastics probably belong to these exceptions, in which the diffusion law is also usuable. The difference can be great if the packing material is touched on one side by water or water vapor, so that it is necessary to make the determination of permeability to water vapor according to their use in practice. Table 1 gives some examples. Packing materials, which have, in practical use, too high values of permeability to water vapor if they get in touch with water or ice, can be useful if only water vapor effects it (wrapping in paper) (Table 1, No.5a, 6, 7a).

If the quality of the closure of a packing is to be proved, (e.g. of a bag) the permeability to water vapor of the packing material alone must be known, and because storage is always under latent air, it is necessary to obtain information about the influence of air movements (Tab. 1). The permeability to water vapor of paraffined paper and some cellglass foils is 1.3 - 3 times as high at an air speed of 2 m/sec., than in latent air.

For producing filled packings, ready for the trade, the packing materials must be folded several times. This possibly causes damages (fine fissures, porous places, etc.) but they do not cause a perceptible increase in the permeability to water vapor. The influence was especially low with lacquered cellglass.

metal foils laminated between paper, with cartons which were lined to each other with gumlike plastics and papers impregnated with paraffin-plastic-mixtures (increase on an average of 30 %), and remained in the limits of the average test values.

Low values for permeability to water vapor have been found viscose foils lacquered on both sides (Tab. 2, No. 1 - 3), plastic foils of polyvinylchloride (No. 8, 9) which can be used as substitutes for the Latex-Pliofilm foils made with foreign raw materials, lined aluminum foils (No. 13 - 15, 30, 31) specially lined plastic foils (Luvitherm, Igelit), packing materials lined with paraffin and gumlike plastics (No. 17, 18, 32, 35, 36, 37) or impregnated (No. 21, 23, 33) and also with lacquered artificial parchment (No. 25, 26).

b) Losses of weight of freezing packings.

A loss of the quality of frozen foods can also occur in the way of taste, as well as that caused by losses of weight. If the losses of weight can be kept small enough so that a freezer burn can hardly be recognized, there will be hardly any decrease of quality. With increasing losses of weight the frozen goods lose their natural freshness, become dull, afterwards light, ugly, unequal spots or stripes appear. Of the contained materials the layers at the sides of the packing are affected first (c. Schröder-effect).

By variation of temperatures a greater evaporation towards the middle can take place in contained materials with airgaps so long as the wall temperature of the package is lower than that of the contents and on account of the higher vapor pressure in the middle of the package, condensation and formation of ice at the outside layers is caused.

Because irregular evaporation damage the packages, the test can not be done with single fruits, vegetables, fish, etc., but preferably ought to be done with the usual packages because statements about damages caused by losses in weight only them can be used in practice. In this case a series of vegetables and fruits were packed into "Stülp-boxes" of 800 ccm contents; to obtain a quick result, these

were wrapped into a paper with great permeability to water vapor, stored at -18°C and about 80 % relative humidity. The losses in weight refer to the weight of the contents in filling.

With products the changes caused by evaporating are not always the same; e.g. with fish are a little different than with fowls. In particular, observations stated in table 3, were done with some vegetables and fruits.

The sensitivity of vegetable and fruit types to losses through evaporation is different and with indelicately natured epidermis the growing of hair is less. In using sugar or sugar solutions the losses of weight gets less, because of the decrease in the vapor-tension-fall. If the surface is protected by a film of a sugar solution not frozen at -15°, the damages of evaporation usual recede. Beans, spinach, peas and raspberries have proved especially delicate. If the losses of weight are not too high, the freezer burn disappears in thawing. Therefore one could think of allowing certain evaporation damages and greater losses of weight. But because the frozen goods can only hold their own against canned goods (at present only because of lack of metal) if the quality of fresh goods is preserved as well as possible, only frozen goods of best quality should be used for marketing.

It is advisable to choose the diffusion number of the freezing packing so that the losses of weight per selling period do not go beyond 1 % or at most 1.5 %. For fish, Cursiefen has proposed a maximum value of 2 %. According to our last measurements, this value must be lowered to about 0.8 % per year. In view of uniform packing, it is not advisable to use packings with greater vapor permeability for products not very sensitive to evaporation damage. Further tests shall be done to find out if for frozen goods with a low vapor tension (sugared products) the production of a packing material with a not too low vapor permeability is advisable, to obtain a broader raw material basis.

c) The permeability to water vapor of freezing packings in the freezing room under practical conditions.

If the losses of weight, allowed in one selling period (at the latest, 1 year) are known, the necessity is clearly shown for determining the distribution of diffusion resistances in the single layers of a large packing customary in the trade (outside packing with a number of small packs) during storage in the freezing room in order to guarantee a sufficiently small permeability to vapor. The values found in laboratories can not be taken as a starting point of such considerations, because the experimental conditions do not agree with the air conditions of the freezing room, and besides, losses at slits (especially at closings) and diffusion resistances in the thin air layers between the small packs, etc., are not considered.

A series of packages were put into the freezing room at -15°C. with an average atmospheric moisture of 70 % and quiet cooling, and the losses of weight were measured in relation to the time of storage. Untreated boxes of a chromous substitute carton, (Chromoersatzkarton), "Stülp-boxes" of the same material, lined inside with parchment, waxed at the outside (800 ccm contents) "Eco-Packages" (800 ccm), cellophan AST, Ultraphan (unlacquered), Cuprophan (lacquered on one side), parchment impregnated on both sides with paraffin were used. The wrappings which can not be glued by heat were cemented with a mixture of paraffin and Oppanol. The small packs contained wet cell wadding instead of frozen goods. In these so-called damp rooms an atmosphere is formed similar to that of freezing packages filled with vegetables or fruit. The inner bags were filled with water and enough air space to prevent them from bursting while freezing. All packages have been set up in the freezing room so that the air could get at them better. Several experiments could be done with the packing material, which is seen on table 4. The valuation was done as follows: the loss of weight was graphed on the line for duration of storing (pict. 1) and the loss per time unit determined on the linear part of the curve. To find out the losses of weight per time and level unit for the small package surface of about 5,8, for the outside package, one of about 60 qdm surface was used. (Table 4).

The results, found experimentally, were proved and completed by calculation. If one sees in the vapor permeability a diffusion process, one can write, analogous to the temperature permeability

$$Q = \frac{F \cdot \Delta t \cdot Z}{\Sigma\left(\frac{\delta_n}{\lambda_n} + \frac{1}{\alpha_n}\right)} = (\text{kcal}) \text{ .... } 1)$$

F is the level qcm, Δt the difference of temperature (°C) between the inside and outside of the wall of the package, Z time (in h), δ thickness (cm), λ the value of the thermal conductivity (kcal/cmo, C,h) and α number of temperature exchange between the packing material and the air (in kcal/qcm°C,h) for the exchange of material (at t = const.)

$$G = \frac{F \cdot \Delta C \cdot Z}{\Sigma\left(\frac{\delta_i}{k_i} + \frac{1}{k_{oi}}\right)} = (\text{g}) \text{ .... } 2)$$

If G is the transferred amount of vapor (g), ΔC = the decrease in the concentration of water vapor (g/ccm) from inside to the outside of the package, δ the thickness of the layers, through which the diffusion takes place, k_i their diffusion numbers (cm^2/s) and $^1/k_{oi}$ specific surface resistance (s/cm) (other notations as Fo No. 1). To get around the difficulties in obtaining the diffusion numbers and thicknesses (e.g. that of the air), according to the thermal permeability number k (kcal/qm, °C, h) the denominator of equation 2 has been replaced by a constant for the vapor permeability, which states the vapor permeability (g) per level unit (qcm), time unit (s) and unit of the fall of concentration (g/ccm). If the package consists of two separate layers of which the constants of vapor permeability are C_{d2} and C_{d3}, and if one replace the simplified denominator of equation 3) by R_3 or R_2, so, because the numerator in equation 2) in any case remains the same,

$$C_{d_3} = \frac{1}{R_3}, \quad C_{d_2} = \frac{1}{R_2} \quad \text{and } C_{d_1} = \frac{1}{R_2 + R_3}$$

So the constant of the whole package is

$$C_d = \frac{C_{d_2} \cdot C_{d_3}}{C_{d_2} + C_{d_3}} \text{ .... } 4)$$

Because one can assume, with a large package which consists of an outside carton and a small package that between these the diffusion of vapor is negligible, the inner level of the outside carton was used as a common

middle level for giving off vapor to the surroundings. If one chooses one of the constants as a "parameter" and graphs it in dependence of the two other curves, series of hyperbolas are formed (pict. 2) from which is clearly to be seen that the constant for the whole package C_{d_1} always must be smaller or the same as the constant of a partial package. In these are alike, C_d has the half value. If a constant of partial package decreases from this point to the value C_{d_1}, the other grows to infinity. C_{d_1} falls quickly in the region of small values for C_{d_2}, or C_{d_3}. The diffusion number k and also C_d, increases quickly with the increase of the average value of the atmospheric moisture in front of and behind the packing material, which was proved by Lehmann-Oliva with cardboards. The same author assumes that the law of diffusion is valuable for cardboards (influence of vapor).

If the equation 4) solves towards C_{d_2}, its use is limited, as the differents $C_{d_3} - C_{d_1}$ has smaller values, which approach the order of magnitude of experimental accuracy. (The permeability to water vapor can be different for the same packing materials in tests on different parts of the paper sheet on an average of about 30 %; in some cases a maximum about 100 % and more). The calculation is simpler if R, instead of the numbers for the whole diffusion resistance, is the constant for vapor permeability C_d with the reciprocal values. Then $C_d = \frac{1}{R}$ (see above) and $R_1 = R_2 + R_3$. The values can easily be calculated from table 4 (part with values C_d).

Because of this assumption, a total conformity with reality can not be expected (especially in touching the packing with liquids). How far the appearance (called v. Schröder-effect) works out in practice, has not been determined. The results given in pict. 3 nevertheless give a good criterion for construction of freezing packages for practice.

By using a simple, untreated folded box the water evaporation of the free ice level was reduced (tab. 1 and 2) to about half and by using only corrugated card-board (No. 4 pict. 3a) a further reduction is possible. Its improvement by a thin "Bitum-paint" is insignificat. If instead of the corrugated cardboard is used, losses of weight increase.

The losses of weight of the small packs, which are put into a corrugated cardboard carton (4 layers per 8 boxes) remained the smallest in the middle layers, at the top and at the bottom they were about twice as large, whereby the losses at the top layer are a little above the bottom layers. This sequence was observed in all experiments (pict. 1) therefore the bottom and the cover of the carton were especially protected against losses by evaporation.

It is known that the permeability to vapor can be considerably reduced by suitable impregnating agents. One obtains a much smaller constant C_d for impregnated "Stülp-box" alone in spite of the fairly big split openings than for the whole package of corrugated cardboard and untreated boxes. The same result can be obtained if the untreated boxes are wrapped into impregnated paper and stuck together by heat (tab. 4, No.7, pict. 3c). The calculation gives the same value although the resistance of the thin air layer between box and wrapping paper was not considered. It seems that the resistance of such air layers practically are of no importance in view of the possible test errors. Furthermore examination has shown that in using small packages with little permeability to vapor, wrapping papers or foils can be used whose permeability to vapor is clearly above that of the known cellophan-AST-foil (see tab. 4 No. 11 - 18 and 19 - 30).

In combining two materials of higher diffusion constants one after another, sufficient small losses of weight of the whole packing could be obtained. In experiments Tab. 4 No. 10 and 33, the losses of weight of the small packs remained under 1.5 % per year. The use of such packing materials as wrapping paper led to unreliable losses of weight, if the small packs were untreated (No.9) or omitted (No.13). In the constants of the permeability to water vapor of the wrapping material, found by experiments and calculation (Tab. 4, No.11, 17, 20, 23, 31, 36, 41, 44, 47) the losses caused by the incomplete closure are inclosed. The figures calculated from the values for permeability to water vapor therefore are a little smaller (No. 12 27 32, 37, 42, 45, 48).

The constant of the water vapor permeability of cellophan AST is so small (Tab. 4, No. 15 - 27) that the constants of the other materials have no important influence. In view of the permeability to water vapor it does not matter whether the small pakings are impregnated or not (Tab. 4, No.15, 18, 22, 24, pict. 3, No. 19 - 30). The foil alone would be sufficient to guarantee a sufficient small loss of weight (No.23, 26). The decrease in the constant is noteworthy; if, instead of the wrapper for each small package, a bag is used for all small packages (comp. No.15, 18 and 22, 24). The reason being that the losses caused by splits are much smaller with the big bag than with 32 wrappers.

During storage the values of permeability to water vapor can increase considerably, especially under influence of sour products. Dipping lacquered cellglass types after 14 days in contact with lemon juice (pH 2 at 20°C.) has caused a multiple increases of water vapor permeability. For studies of the changing qualities of the packing material during storage, exact examinations will be made.

The yearly losses of weight of the "Eco-packing" (aluminum foil between 2 water repelling impregnated cellulose cartons) is so small, that the diffusion resistance of the outside packing cam be ignored (Tab. 4, No.38, 39, pict. 3, No. 31 - 33). It must be mentioned that the filling was sugared and the losses of weight of unsugared freezing materials will be accordingly higher.

If the product touches the packing material, the losses are higher (v. Schröder-effect) than when touching the water vapor (Tab 4, No. 40 to 49) and the losses of weight cam get too high with packing materials which could be used as wrappers (comp. Tab 4, No.44 and 36 as well as No. 47 and 11). If packing materials with great permeability to water vapor are used as inner bags, one of the remaining layers of the whole packing must have an accordingly lower constant for vapor permeability.

d) Relationship of permeability to water vapor determined in the laboratory with single packing materials and under practical conditions in the freezing room with completed paskages.

Practical examinations in the freezing room have shown, that the losses of weight will not go beyond the allowed 1 - 1.5 % if the constant for permeability of water vapor of the large packing (32 small packs in a carton of double corrugated cardboard) remains under the values 2.10^{-3} or $3.2 \cdot 10^{-3}$ cm/sec. If the constant for permeability of water of the small package was C_d (Tab.4, No.5), for wrappers and inner bags material could be used for which a permeability of water vapor of 25 - 50 mg/cm^2 was determined by the laboratory method. But if the constant of the small package is very large and should the water vapor be held back from a packing material, maximum values for permeability to water vapor 12 - 14 mg/dm^2, Tg. at -15^0 cam be set.

To make practical tests, the large packing was set up in the freezing room at -15^0C , 70 % atmospheric moisture and latent air. With the laboratory method the determination of permeability to water vapor of packing materials was done at -15^0C , a fall of moisture from 100 to 70 % and an air speed of 2 m/sec. If the packing material is to be used as wrappers for a small package, for measuring the permeability to water vapor, that side of the paper or the foil with higher atmospheric moisture (about 100 %) must be influenced by water vapor, but if the product lies directly on the packing material for measuring, the water should touch it.

Because of the expected fluctuations in production of paper, foils, cartons and their improvements and their influence on permeability to water vapor, it is advisable to keep the lowest values of 12 or 25 mg/dm^2Tg for safety as limiting values.

The limited zone of 1 - 1.5 % losses of weight per year for small packages, with the suitable constants for water permeability of $C_d = 2.03 \cdot 10^{-3}$ and $C_d = 3.17 \cdot 10^{-3}$ cm/sec.,

is shown in pict. 3. If larger packages than the small packages of 800 ccm are packed into the same outside packing, the same limitations are valid, because the active level for evoporation remains the same (only the closing value might be better). If a larger outside packing is used, the proportion of surface in comparison to weight decreases and the losses of weight will be the same only after a longer time of storage; for safety it is good to keep the same limitation in view of damages caused by evaporation. If for the outside packing smaller measurements are chosen, the limitations become a little smaller (correction about proportional to the surface per weight unit of frozen goods).

Permeability to Air.

Atmospheric oxygen can cause deleterious changes in the frozen goods in freezing, storage and thawing. Together with oxydative ferments, it is able to cause changes of taste and aroma, fading and losses of Vitamin C. To prevent these undesired aspects, experiences with the gas cooling storage may be useful. For this the material for freezing must be protected from influences of the atmosphere by use of inert gas or vacuum, which is done easily in metal vessels. For the time being, this can not be done on account of the lack of raw materials. Attempts must be made to exclude atmospheric moisture as far as possible by use of packing materials consisting of fibrin or plastics. Variations of pressure and temperatures cause continual renewing of the oxygen content of loosely closed freezing packings. In using gas-tight packing materials for expensive frozen products, only well constructed closures can be used. For measuring permeability to air of very airtight packing materials the apparatus of "Bekk-Ullstein" is the best commercial apparatus, but does not work under constant pressure. In the development work of Wolodkowitsch, one apparatus has proved satisfactory, in which the very small air space under the fixing place for the test paper is connected with a glass capillary in which a constant diminished pressure is held by a mercury thread of regulated length; (mostly 15 mm). The time is measured during which the mercury thread moves a certain way in the capillary as well as

the air-volume drawn through the tests paper, where upon the air quantity per time and level unit can be determined. The temperature must be held constant. Variation of air pressure easily cam be considered. According to this arrangement a good many of the values given in table 1 were found.

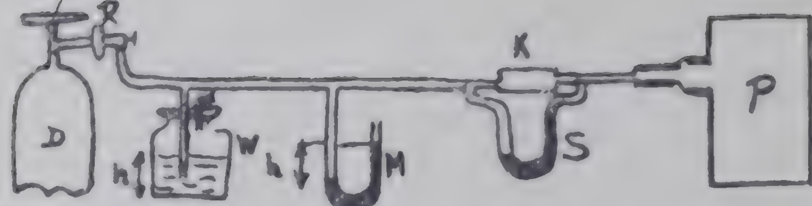
As air-tight packing materials, cam be mentioned the cell-glass types (Viscose-, acetylcellulose-, cupric oxide foils, table 1, No. 1 - 7), plastic foils (Luvitherm, Igelit, see tab. 1, No.8, 9), foils on caoutchouc bases (No.11, 12), aluminum foils, especially if they are lined (No.13 - 15), papers lined with paraffin plastix mixtures impregnated (tab. No.17, 18, 22) and lacquered papers (No. 25, 26). Sometimes metal foils are porous, which causes great permeability to air. By laminating other packing materials, especially cell-glass or plastic foils (e.g. Igelit-foils) this disadvantage can be totally removed. If packing matérials are usually airtight to existing temperatures, they are also air-tight at temperatures below 0°. (Measured at -15°). But if the state of aggregation changes or if it recrystallizes, the packing material becoming brittle, the permeability to air increases especially at break and groove places, etc. at -15°, and are higher than when they were measured at +20°. Almost always an increase of permeability to air was determined at paraffined papers, if the temperature decreases from +20° to -15° (No.16, 19, 20). By mixing a gumlike plastic (e.g. Oppanol) with paraffin the disadvantage can be removed.

Also cartons can be made air-tight by lining on or between foils or by using lining agents of gumlike plastics (tab. 1, No. 29 - 31, 37). Paraffin plastic mixtures are not always successful.

There is difficulty in the production of packing materials to construct the closures so that the values for permeability to air of completed packings do not become worse.

Measurements of permeability to air have been done at some commercial freezing packings (Pict. 4) in the following way:

Picture 4.



Apparatus for measuring the permeability to air of package (P).
D = Vessel for compressed air with sensitive regulating valve R.
W = Bottle for keeping the air pressure constant in the tubing.
M = Manometer, air quantity meter with capillary K, where it causes a pressure difference in the U-tube S, at which the quantity of flow can be found from calibration curves.

At high pressures the permeability to air was measured 7.5 and 15 cm WS, and proved to be about proportional. Tab. 5 gives 5 average values per 10 single measurements. As the table shows, the different packing materials can be improved. Under-water (or immersion) tests show that by using the heat-glutination-method (tab. 5, No. 1, 2) the air comes out especially at the corners and where folds cross each other.

The value depends on how carefully the heat-glutination is done. As inner bags only those with heat-glued filling openings were not tight. The values of tab. 5, No. 2 were obtained with bags carefully heat-glued by the producing firm. With temperarily glued bags the permeability to air was 1-7.1/h°. Two glutination seams together gave small values.

Table 5.

Permeability to Air of commercial freezing packs.

(Middle values at 10 measurements).

No.	Packing	Permeability to air at 15 cm W high pressure 1/h
1	"Stülp-box" 800cm³ with wrapper of cellophan AST, heat-glued	1.0 - 3.6
2	Inner bag of cellophan AST	
	flat bag	0.3
	base bag	1.2
3	Parchment-beaker (500 cm³) with metal-bow closure	7.4 - 14.7
4	"Eco-packing" (800 cm³) of 2 cellulose cartons lined in between with an aluminum foil	1.9 - 3.3

5	"Eco-packing" of 2 cellulose cartons lined with paraffin-plastic-mixture	3.0 - 3.3

Seams glued along the side, heat glued bottom and cover seams and corners (No. 4, 5) as well as fold parts (Tab. 5, No. 3) have proved to be porous.

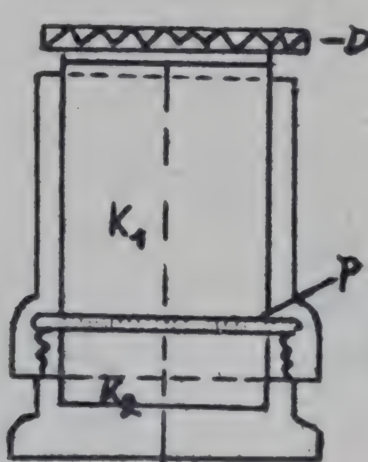
3. Permeability to Odorous Substances.

A number of fresh foods for freezing have a decided, typical smell. The packing material must prevent losses of odorous substances of products and also should not let such substances get into the package. Such strongly smelling foods are raspberries, strawberries, tomatoes, onions, and fish. In measuring quantities of odorous substances there are two difficulties; one, because the substances only exist in traces which requires sensitive micro-methods for measuring, and because there are only mixtures of numerous odoriferous substances, which make it difficult to find out the most active component. The aromatic substances of fruits are mostly volatile oils and esters. For measurement, a certain amount of odorous substance was put into a metal vessel closed by a test piece of the packing material, the amount of odorous substances remaining in the vessel was chemically determined depending on the time. The amount given off can be stated in mg/dm^2 Tg. F. Kiermeier has chosen an acetic ester as odorous substance, found in many fruits, the amount of which could be proved by microanalysis, whereby the ester was oxidized by chromosulfuric acid. Trimethylamin is one of the typical odoriferous substances of fish. The same arrangement was used for finding out permeability to odorous substances of packing materials. The chemical determination was done by titration. Also criterions were given by weighings of small samples, carried out like tests for permeability to water vapor (2, 1), in which F.Kiermeier has put naphthalin as a third odoriferous substance. It is to be seen that those packing materials of little or no water vapor or air permeability also had a small

value for permeability to odorous substances. For the three odorous substances the relative small numbers of 0 and 2 mg/dm^2 Tg. (at 20^0) have been found for the papers and foils given in table 1 No. 1, 2, 3, 4, 6, 19, 22. If either the water vapor permeability alone or at the same time the air-permeability was large, the values for permeability to odorous substances also increased (e.g. at unlacquered copper-foils, papers glued and hardened at the surface). For untreated cellulose paper the value was over 100 mg/dm^2 Tg. These observation can not be generalized for all different types of packing materials and odorous substances. Lacquered viscous foils, e.g., are in spite of high figures for permeability to water vapor and air very permeable the odoriferous substances given off by onions. Air-permeable packing materials will also be permeable to odorous substances, if the molecular quantity has no influence. The determination of relationship between permeability to water vapor, material and permeability to odorous substances shall be tested.

The determination of the quantity of odorous substances must not always be the measurement for the odorous impression. It is advisable to use subjective methods also. With an apparatus (Pict, 5) consisting of two chambers or cells, separated from each other by packing material (P), one cell (K_2) containing the odoriferous

substance



(apparatus for destinating qualitative and subjective permeability to odorous substances of packing materials).

the other one (K_1) has a gas-tight lid (D) which allows the subjective determination of odoriferous substances, it is possible to determine only qualitatively but quicly the permeability and odorous substances. Total impermeability has been found only with aluminum folies (without pores) pure and lined (e.g. carton for "Eco-packings", see tab. 1 No. 31 for structure) and "Luvitherm-foile". Lacquered artificial parchment("Pergamin") (Igraphan, Zewaphan) and a "Duplo-paper" have proved very air-tight. "Pergamin" is fairly tight. Although the foils and paper mentioned before alone should be sufficiently tight against odorous substances, it is advisable to store certain groups of foods like vegetables, fruit, juices or meat, poultry eggs, fats or fish in seperate freezing rooms, because of the insufficient closures.

4. Mutual Influences of Packing Material and Product.

Nearly all foods for freezing have a considerable content of water and some are also frozen in sugar solutions (some fruit types). Before freezing and after thawing the package is influenced by liquids in the package; after thawing the outside (of the package) also is influenced by the condensation water. Undesirable results are losses of liquids, deformation, decrease of hardness.

In the tests for determining the permeability to water, the materials (100 cm^2) were weighted with water having a constant pressure through a "Mariott-bottle" of 16 cm WS (having the same effect as the height of a package of 800 cm^3 content). The packing materials were covered with a glass dish to prevent evaporation.

The tests were done for at least 6 hours, supposing that the liquid before freezing and after thawing does not affect it. Under these conditions most of the samples were water-tight (Tab. 2). In a series of packing materials small amounts of water come out in the form of drops. We have marketed these papers as impervious to water. They should be sufficient for practically dry, but not hydroscopic foods. Untreated or only water repelling packing materials (swelling of fiber retarded for short time) can not be used in contact the freezing goods.

Better criteria for use of packing materials for frozen packages are given by the "Nassberst-druck" (test 1 hour in water of 20°). For this it is advisable to protect the sample from letting the water come through by a mixture of wax and plastics). Until recently no restrictions on minimum demands were given. It is supposed that for normal packings a wetbursting pressure of 0.7 kg/cm² is sufficient for packing liquids in small packages (Tab. 2). Papers not impervious to water (Cellulose paper, parchment substitude, pergamin etc.) can not be made imperrious by paraffing. (Tab. 2, No. 16, 17, 19, 20). Also with impregnations the bursting pressure can be very different in dry and wet condition (Tab. 2, No. 31, 32, 38). The fall of bursting pressure remained within limits on viscose foils, acetylcellulose, "Igelit-", "Luvitherm-" "Pliofilm-foils, lacquered "Pergamin", glued and hardened cellulose papers, lacquered aluminum foils and impregnated parchment, Tab. 2, No. 1-3, 4, 8, 9, 12, 15, 22, 25, 26, 37). But also a number of carton types, with a pronanneed fall of bursting pressure through influence of water, were used in the refrigeration-industry (comp. e.g. No. 31, 32, 33, 34).

In production of completed packages it is demanded that all closures be water-tight (which is not easy in mass-production. Experience has shown that nearly all packages with fiber bases are more difficult to make tight against fruit juices and spinach liquid, than against water. It must be observed that during long storage in the freezing room, water vapor can get through pores, fine splits of the impregnation, the impregnation itself as well as through edges into the swellable packing material and dissolve even water-tight cements and linings. Such diffioulties can not yet be mastered and it is one of the most important problems to find a frozen food package sufficiently water-tight for requirements in practice.

As result of the swelling (different expansion of foil and lacquer layer) the lacquer layer of the cell glass type "Wetterfest" (weather-proof) can loosen after a longer contact with damp goods. (Tab. 1, No. 2, 3). In such cases (packages for fish, fruit and sugar-solution) only cell-glass can be used, where the lacquer layer by a special treatment adheres water tight to the base. But a loosening of the heat glued parts also can be observed in these types.

Most vegetable types show a weak acid reaction, but for all fruits the pH value is lower and can decrease for lemons to 2[16]. Against influences of fruit acids are aluminum foils especially sensitive (Tab. 2, No. 15), they must be protected by suitable lacquers and linings. Reliable results with this method only can be obtained if the package is sufficiently water tight, so that damages to the aluminum foils, used for testing purpose, only can reflect influences of the fruit acid. This is not a disadvantage. because non water tight packing materials can not be used for frozen packages. Resistance against fruit acids is not of great importance, it can easily be conferred on the packing material used in frozen packages. Polyvinylchloride-foils are absolutely acid proof.

For fat-fastness of packing materials for meat, fish and fat no new viewpoints have appeared. The tests were made on lard according to the provisions of DIN RAL 1881 b but the testing took 3 days at 25°. All packing materials given in Tab. 1 (except No. 16) have proved sufficiently fattight.

The package also must not change the products to their disadvantage, e.g., by giving off a taste of carton, lacquer solutions or by other chemical influences. If the frozen package is opened, it only must have the typical odor of the content.

5. Some Mechanical Requirements For The Frozen Package.

Besides the arrangement of products (preventing air-spaces) the permeability to warmth of the package is of some importance in obtaining a sufficient short freezing time. Because at the same time it has to have a degree of stability (strain in storage and transport, etc.) a satisfactory balance between this and permeability to warmth should be used. Usually for the use of normal packages (800 cm^3) cellglass or plastic foils of about 300-450 $gr./m^2$, papers of 45-85 g/m^2, cartons of 300-450 g/m^2 are sufficient. The stability qualities of these packages under dry conditions are known and were sufficient for the requirements of frozen packages. More important is the behavior under influence of dampness which was mentioned above (Section 4).

A decrease of stability as a result of the freezing procedure until recently was observed for fleeces of unbleached sulphite cellulose with high content of water (decrease of the bursting resistance, and shaving number). Although the use of unimproved packages is not of such importance, it must be assumed, because of the long storage and the great atmospheric moisture, that the improved originally dry packages absorb moisture. The decrease of stability is caused mainly by the content of water and not so much by the freezing procedure.

The packages, lining agents, lacquer films and cemented parts must not get brittle at the usual temperatures in the freezing room of -15 to -20° C. These qualities were not tested by measuring. The trade expects a degree of flexibility. This stands in relation with the elastic and plastic behavior of the materials. There is no measurement for flexibility yet, but one can get criteria on the number of double foldings (Tab. 6); in comparence to measurements at +20° the figures became smaller at -15°. Especially, papers with paraffin containing intermediate layers (No. 17) lose a great deal of their flexibility at -15°, if a suitable softening agent in not added. First, it was believed to be sufficient, if at -15° in each direction at least value were achieved, which according to Herzberg were named "Farrly high".

Because of its simplicity the heat-glutination arrangement for closing bags and wrappers has become common.

The main function of the lacquer layer is to gaurantee low permeability to water vapor, but the lacquer upon heating also effects a glutination. This property causes an increase of permeability to water vapor at the seam. The quality of glued seams answer requirements especially for dry products but for stability and tightness in packing liquid goods they could be better. Testing methods for proving tightness of seams have not yet been developed. Some qualitative statements are mentioned in Tab. 2.

Cartons sometimes incline to adhere, and parts of it stick to the product, when this is taken out in frozen condition. In the "Birdseye apparatus" it can happen that the small packages freeze to the plates. This disadvantage can be prevented by the use of suitable impregnating agents

(e.g. paraffin plastic mixtures). A control test is made by letting strips of the package freeze to a thin layer of ice. In tearing off, the strips must come off without leaving parts of it sticking to the ice. To obtain reliable results, tests must be done on different foods, because they react differently with respect and freezing on. Paraffined cartons and papers and also lacquered packing materials (e.g. cell-glass "weather-proof") have been approved.

6. Studies on Improving Packages and Their Possible Applications.

Two more materials (Transparit "weather-proof" KT, Heliozell "weather-proof" HT) have been added to the first existing cellophan type AST in which the lacquer layer is attached so tightly to the cellulose hydrate foil that even after a long influence of water (at temperatures to 100°) it can not be loosened. Instead of the packing foils developed in foreign countries, plastic foils are used which are distinguished by a low permeability to water vapor, impermeability to air and many odorous substances and resistance to water diluted acids and alkalies. Its good wet strength should make this material especially suitable for production of bags for wet products. But because of its insensitiveness to numerous solution agents it is difficult to find adhesive substances. By new developments the difficulties seem to be removed. It is possible to complete properties of single papers and foils by laminating different packing materials together. A package, which is very impermeable to water vapor, water and fat can be produced by using aluminum foils which are not always free of pores, and especially have to be protected against corroding.

Packing materials produced by lining aluminum foils together with weatherproof cell-glass foils or plastic foils (Luvitherm-, Igelit foil). By lining lacquered cell glass on cardboard the permeability to water vapor increases appreciably in comparison to cell-glass weatherproof alone. According to the latest methods this disadvantage is prevented by linings; lining of carton and cell-glass are done only at seams and other closures (e.g. inside dressing of beakers, boxes, etc.). The permeability to water vapor of paraffined

impregnations is decreased in the U.S.A. by admixing caoutchouc and also the flexibility is improved. For the same purpose we have gumlike plastics, e.g. Oppanol-B. In lacquering pergamin packages were produced, which are just as good as the weather proof cell-glass with respect to permeability to water vapor. At the same time the water tightness on untreated pergamin was improved considerably. There is difficulty in removing all the solvents (odor problem) and production of a sufficient flexibility. The get rid of the smell, attempts were made to apply lacquers without the use of solvents. Frozen goods are kept in small packings (to 1000 g) or in big packings (e.g. 3 to 4 kg) a certain amount of them are put into an outside packing. For big packings with more solvents, portal outside packings and boxes are chosen, which have been made suitable for frozen goods by inner bags or by covering with papers and foils. For fulfilling all requirements of frozen packages all different layers can be used. A number of possibilities for this are mentioned already in an other place.

Summary.

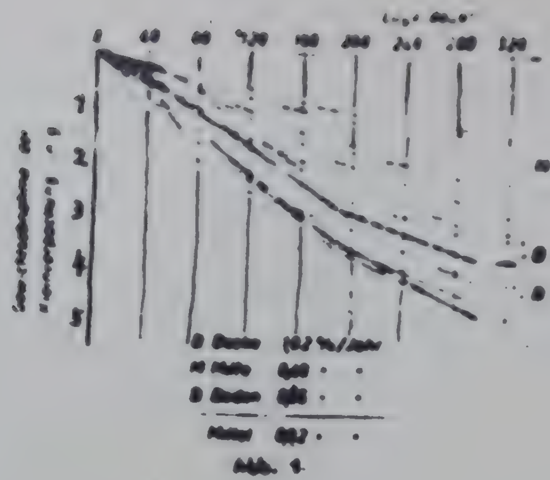
Measurements were done on permeability to water vapor, air-permeability, the number of double creasings at $+20^0$ and -15^0C., on permeability to odorous substances, the water and fat tightness, the influence of fruit acids, and the bursting resistance in dry and wet condition at $+20^0$C. The examinations give information about the useability of packing materials for production of freezing packages. The results are explained in complete tables.

The packing of frozen goods has to solve important problems to keep the products fresh. The properties of the packages is also dependent on conditions necessary for keeping fresh. This refers especially to the limiting values for water vapor permeability, air-permeability and permeability to odorous substances. Systematical examinations have shown that the allowed losses of weight on 1 - 1.5 % per selling period is not exceeded under the usual air conditions of freezing rooms for preserving the value of frozen goods. For this, double corrugated cardboard as outside packing and impregnated boxes as small packings (cd 6) must be used as wrappers or inner bags with a permeability to water vapor at -15^0

of about 25 mg/dm^2 Tg. measured according to the laboratory method of Wolodkewitsch. If the water vapor is to be retarted from a packing layer, 12 mg/dm^2 Tg. should be given as limitation for permeability to water vapor. For measuring, the outside of the package with high vapor pressure must be touched by the water vapor (rel. moisture about 100 %) if the paper or the foils is supposed to be used as wrappers, but if the packing material is to be directly in contact with the wet product it should be touched by the water or ice. Because of the different properties of papers and foils (different diffusion number) reliable conclusions on permeability to water vapor at lower temperatures can be made in relation to permeability to water vapor at high temperatures.

Tests for determination of limitations of permeability air and odorous substances could not yet be done, so that the value should only be kept as low as possible. Al these values referring mutual influences of packages and contents as well as their mechanical straining only can be stated according to experience and conjecture.

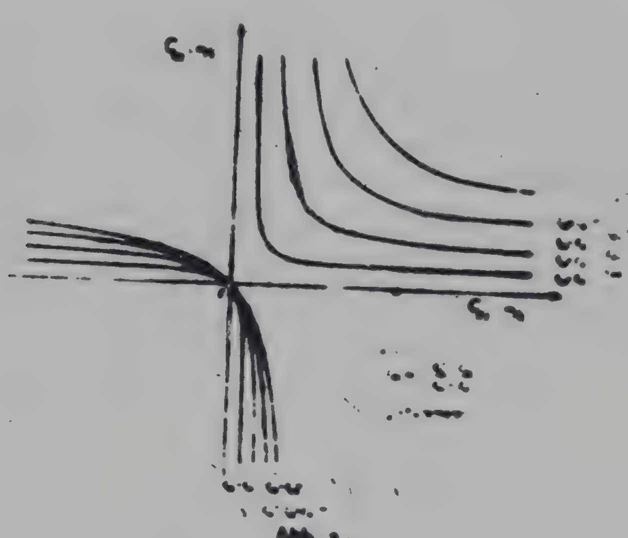
The measuring of permeability to water vapor and air was done partly by N. Wolodkewitsch together witn K. Wörner and the technical assistance of B. Neder. At the examination also have been working the technical assistants I. Howald, G. Metzger, N. Gluntz and I. Hintz. All of them are to thanked at this place. Mr. Schoppmeyer, Kempten, is to be thanked for his advice on his experience regarding packages.



Picture 1

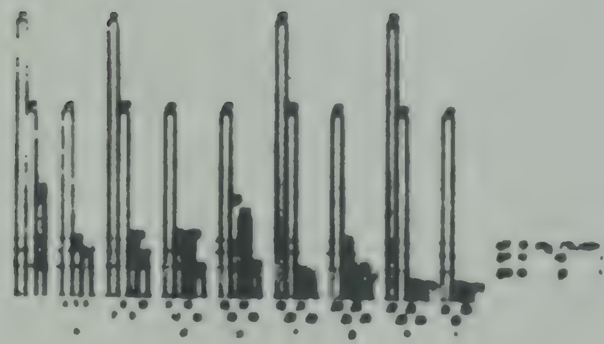
Losses of weight with small packages (impregnated "Stülp-box" with Cellophan AST wrapping. Comp. Tab 4 No.16) in the carton of double corrugated cardboard at -15°C., 70 % atmospheric moisture and latent air.

$$C_d = \frac{1}{\Sigma\left(\frac{d_i}{k_i} + \frac{1}{k_{oi}}\right)} \text{ (cm-s) } \ldots\ldots\ldots \text{ 3)}$$



Picture 2

Dependence of the water permeability-constant of one package part Cd^2 (e.g. of a corrugated cardboard carton) to the constant of a second part of the package Cd^3 (e.g. folded- or "Stülp-box" etc.), the constant of the total packing Cd_1 (of the corrugated cardboard carton and the boxes) is the parameter.



Picture 3

Constant for water vapor permeability (Comp. Tab. 4) for

a) 1. untreated folded box, 2. carton of double corrugated cardboard, 3. corrugated cardboard carton, 1 + untreated folded boxes.

b) 4. Corrugated cardboard carton, 5. impregnated "Stülp-box", 6. constant for 4 and 5 together.

c) 7. Folded box of chromo substitute carton, 8. corrugated cardboard carton, 9. parchment wrapper impregnated on both sides, 10. constant for 7., 8., 9. together.

d) 11. corrugated cardboard carton, 12. "Stülp-box" impregnated, 13. wrapper like 9., 14. constant for 15, 16, 17 together.

e) 15. corrugated cardboard carton, 16. "Stülp-box" impregnated, 17. wrapper or Cuprophan, 18. constant for 15, 16, 17 together.

f) 19. folded box untreated, 20. double folded corrugated cardboard carton, 21. wrapper of cellophan AST for all untreated boxes, 30. constant for 27, 28, 29 together.

i) 31. corrugated cardboard carton, 32. "Eso-packing", 33. constant for 31, 32 together.

Table 1

ermeability to water vapor under influence of water or ice (relative moisture ~100%) and water vapor relative moisture 97%) on one side of the packaging material and water vapor (at +20° relative moisture 0%, at -15° relative moisture 70%) on the other side of the packaging material. Permeability to water apor on latent and circulating air (2m/s).

Packing material	weight	permeability to water vapor in circulating air in mg/dm² Tg under contact with A) water	B) water	C) ice	D) water vapor	permeability to water vapor in latent air in mg/dm² Tg, at -15 and contact with E) ice	F) water vapor
foils of viscose:							
lacquered on both sides I	35	310	95	-	-	-	-
" " " " II	40	205	105	-	-	-	-
" " " " III	40	350	187	8,7	4,5	6,5	3,4
" " " " IV	35	109	55 & 65	2,0	-	1,0	0,7
foils of cuprioxide							
lacquered on one side a)	35	8136	815	262	54	100	25
" " " " b)	35	-	-	450	116	353	75
foils of acetylcellulose							
not lacquered	25	3389	1800	70	29	41	23
parchment bothside with							
paraf a)	85	330-1600	90	263	44	60	20
fin plastic mixtures							
impregnated b)	-	-	-	1550-1750	190-245	350-510	108 - 126
Luvitherm foil	35	33		26	-	-	-

Table 2

Properties of Packing materials for the Freezing Packings

No.	Packing materials	weight g/m²	permeability to water vapor mg/dm² day + 20°	-15°	air permeability cm³/dm² day + 20° 50-60% r.F.	-15° 70% r.F.	influence of water[2]	fruit acid[3]	bursting pressure at dry	wet	[illegible] wi he
	Foils										
1	foils of viscose lacquered on both sides, pattern A	35	65-160	2	0	0	wd[5]	1	1,25	0,7	g.
2	B	40	110-140-250	3-5,6-9,5	0	0	wd[6]	1	1,65	0,8	r.
3	C	40	205-290 (105)	8-9	0	0,1	wd[6]	1	1,0	1,17	g.
4	acetylcellulose foils not lacquered	25	3389 (1800)	35-57-70 (29)	0	0,16	wd	2	2,63	2,45	n.
5	cupricoxide foils not lacquered	35	22000[7]	280[7]	0	0,1	wf.	3	2,46	1,09	n.
6	cupricoxide foils lacquered on 1 side	35	8136 (815)	263 (54)	0	0,4	wf[8]	3	-	-	n.
7	cupricoxide foils lacquered on 2 sides	38	1050 (275)	16,4	0	0,4	wd[8]	1	2,85	1,28	s.
8	polyvenylchloride foils (Luvetherm)	47	33 (26)	1,3	0	0	wd.	0	1,8	1,8	n
9	(Igelit)	42	38	1,2	0,4	0,4	wd.	0	1,1	1,4	n
10	Superpolyamid foil	44	1240	50	0	0,2	-	-	-	-	n
11	Latex[9]	9	31	-	-	-	wd.	-	-	-	[illegible]
12	Pliofilm[9]	35	59	-	-	-	-	-	-	-	g
	Lined packing materials										
13	aluminium foil (0,009) lined on parchment	77	14	2,5	0	1,1	wd.	1	-	-	n
	paper lined on both sides with Alu-foil (with protective varnish)	174	3	0,08	0	0,5	wd[10]	1	3,94	0,8[15]	n

Table 2

Properties of Packing materials for the Freezing Packings

Packing materials	weight g/m²	permeability to water vapor mg/dm² day + 20°	permeability to water vapor mg/dm² day -15°	air permeability cm³/dm² day + 20° 50-60% r.F.	air permeability cm³/dm² day -15° 70% r.F.	influence of water²	influence of fruit acid³	bursting pressure at dry	bursting pressure at wet	[illegible] with heat
tissue paper lined together with paraffine	68	3500	150	800 000	1 600 000	F.r.	3	-	0	n.s.
2 Pergamin papers lined with paraffine plastic mixtures	135	108 (42)	1,5	0	0,8	breaks	1	2,2	[illegible]	n.s.
2 lacquered Pergamin papers lined with paraffine plastic mixture	109	72-94	5,4	1,0	0	wd.	0	3,76	1,66	n.s.
Impregnated papers										
Pergamin 2 sides paraffine I	45	40-315 (15)	16-100	0	38	F.r.	2	1,75	0,2	n.s.
Pergamin 2 sides paraffine II	53	3300	160	0	700	F.r.	2	1,02	0	n.s.
wood pulp paper impregnated on 2 sides with Oppanol-aluminium pulp mixture	150	250-1000	19	6500	2 000 000	wd.	4	1,82	0,68	n.s.
parchment 2 sides impregnated with paraffine plastic mixtures	85	330-1600 (90)	263 (44)	0	0	wf.	2	2,6	,99	n.s.
cellulose paper impregnated with kind of latex plastic emulsion on 2 sides		6-80-493-1600-5375 12	-	-	-	wd.	-	-	-	-
sulphite pulp impregnated with Adsorbin		7200	668	1 200000	-	0	3	2,02	0,95	n.s.
Lacquered papers										
Pergamin lacquered I	66	91	0,7	0	0	wd.	1	1,94	1,35	g.s.
" " II	56	186	5,4	0,1	0	wd.	1	1,32	0,99	g.s.
Cellulose paper sized and hardened										

28	make II Card Board	65	14000	420	53	46	wd.	2	2,25	1,40	n
29	viscose foil lacquered (35 g/m^2) lined on card board	567	1200	40	0	0	wd.[13]	1	-	-	
30	aluminum foil (0,012mm) lacquered on card board	195	3	0	0	0	wd.[13]	1	-	-	
31	Alu foil lined between 2 impregnated cellulose card boards	498	54	1,3	0	0	wd.	0	11,6	~ 2	
32	2 cellulose card boards impregnated with paraffine emulsion and lined with paraffine plastic mixture	494	40	2,9	0,5	0	wd.	0	10,8	~ 3,3	
33	Chromo substitute card boards impregnated with paraffine emulsion in the pulp both sides paraffined	385	308	20	2500	2000	wd.	2	3,3	~ 1,1	
34	card board impregnated with paraffine emulsion (30^0/oig)	407	5300	636	2-7	69	wd.	3	>10	4,0	
35	card board impregnated in pulp with paraffine emulsion as well as lined with plastic emulsion	375	462	12,9	38000	-	wd.	0	-	-	
36	2 card boards lined together with filmforming intermediate layer	261	78	0,6	430	-	wd.		-	-	
37	2 card boards lined with mixture of plastic, latex like, and with waxes, surface impregnated with plastic-emulsion	620	110	0,5	0	0	wd.	0	6,6	5,6	

Table 2

Properties of Packing materials for the Freezing Packings

Packing materials	weight g/m^2	permeability to water vapor mg/dm^2 day + 20°	-15°	air permeability cm^3/dm^2 day + 20° 50-60% r.F.	-15° 70% r.F.	influence of water[2]	fruit acid[3]	bursting pressure at dry	wet	glutinat with heat
card board impregnated with Isolit	323	2000	.45	180	30	wd.	2	5,7	0,7	-
chrome substitute card board with Bitum layer	256	6000[7]	236	600000	-	wd.	0[14]	3,4	1,6	-

T a b l e 3.

Change of appearance through losses of weight of the normal packa

(800 cm^3 content).

Content	loss of weight %	Appearance at -18^0,=077	Appearance after thawing	Limitation loss of wei where produ is still of best qualit %
Spinach	0,70	normal	-	1
	1,5	drying clear	normal	
	1,95	" very strong	nearly normal	
	3,44	" " "	" "	
	0,79	surface little dull, pressure marks show small appearance of drying	-	
	2,50	at pressure marks drying not very clear, appearance not very fresh	normal	
Straw-berries without sugar	3,68	surface dull, drying of the pressure marks, stalk clear, appearance bad	nearly normal	2,5.
	5,70	more marked than 3,68 %	nearly normal	
	7,50	surface not very clear, drying appearances very strong at pressure marks, general view remarkably bad	drying appearances stay, fruit fallen together	
Black-Cherries (sweet cherries with 80 g sugar for each package	1,86	Through use of sugar or sugar solution losses of evaporationare reduced, surface remains moist and drying appearances are avoided		
	2,2	surface dull where no film of sugar solution	surface dull where no film of sugar solution	
	1,2	surface starts to look dull natural freshness is lost	normal	
Raspberry without sugar	2,4	surface clearly dull	nearly no influence	1 - 1,5

Content	loss of weight %	Appearance at -13^{0},=077	Appearance after thawing	Limitation for loss of weight where product is still of best quality %
...pberry ...hout ...ar	3,5	surface with clear drying appearance	drying appearance visible, fruits fallen together a little	
	6,5	" "		
	0,49	first drying traces	-	
	0,92	drying appearance weak, but clear	-	
	1,51	drying appearance very clear (irregular limited spots)	-	1 - 1,5
...s	2,92	drying appearance strong, appearance bad after melting	drying appearance after melting still visible	
	3,92	drying appearance stronger than 2,92 %		
...ck- ...ries ...h 100 g ...ar/ ...king	0,92	condition like cherries with losses of weight 1,86	-	-
	1,6	no change of the surface	-	
	0,96	clearly traces of drying (especially where berries are lying close to packing and at carton in form of spots and stripes	-	1
...as ...xa)	1,92	drying appearance strong	drying appearance very clear	
	3,1	drying appearance very strong, appearance bad	drying appearance very clear	

Table 4

Losses of Weight and Constants for the Permeability of Water Vapor the Frozen Food Packages.
Storage at -15° C, 70 % air moisture in latent air and in the freezing room.

No	Packing: out side package	Packing: small package	wrapper for small packages	losses of weight: P %/year	losses of weight: G^+ g/dm² year	constants for medium water vapor permeability $C_d^+ \left(\frac{cm}{s} 10^{-3}\right)$	notes
1	-	free ice level	-	-	87,1	66,3	test
2	-	folded box of chromo substitute card board 800 cm³	-	45,6	39,4	30	test
3	card board of double corrugated board for 32 Kl_3 packing 800 cm³	"	-	5,9	15,8	12	test
4	"	-	-	9,8	26,3	20	calculation of 2 and 3)
		Stülp box(chromo substitute card board water repellent, steam proof impregnated	-	8,3	7,2	5,5	calculation of No 4 and 6
6	carton of double corrugated card board	"	-	2,1	5,6	4,3	test
7	-	folded box of chrome substitute card board	parchment with paraffine plastic impregnated	7,8	6,7	5,0	test
8	-	"	"	7,5	6,5	4,96	calculation of No 2 and 11
9	carton of double folded card board	"	"	1,97	5,25	4,0	calculation of No 8 and 4
10	"	Stülp box(chromo substitute card board water repellent, steam proof impregnated)	"	1,23	3,3	2,5	test
11	-	-	"	-	7,8	5,96	calculation of No 10 and 6
12	-	-	"	-	~7,3	~5,5	calculation (of table 1 No 7a)
13	carton of double folded card board	-	"	2,26	6,04	4,6	calculation of No 10 and 5

Table 4

Losses of Weight and Constants for the Permeability of Water Vapor the Frozen Food Packages.
Storage at -15° C, 70 % air moisture in latent air and in the freezing room.

-	Stülp box(chromo substitute card board water repellent steam proof impregnated		1,4	3,8	2,9	calculation of No 10 and 4
carton of double folded card board	Stülp box of chromo substitute card board	cellophane AST.	0,94	2,5	1,9	test
-	"	"	3,7	2,76	2,1	calculation of No 15 and 4
-	-	"	-	2,96	2,26	calculation of No 15 and 3
carton of double folded card board	Stülp box (chromo substitute card board water repellent steam proof impregnated)	"	0,82	2,2	1,67	test
-	"	"	3,2	2,4	1,82	calculation of No 18 and 4
-	-	"	-	3,5	2,75	calculation of No 18 and 6
carton of double folded card board	-	"	1,18	3,15	2,4	calculation of No 18 and 5
"	Stülp box of chromo substitute card board	bag of cellophane AST.for 32 small packings	0,47	1,25	0,95	test
-	-	"	0,51	1,35	1,03	calculation of No 22 and 3
carton of double folded card board	Stülp box(chromo substitute card board water repellent steam proof impregnated	"	0,48	1,28	0,97+	test
"	-	"	0,58	1,55	1,18	calculation of No 24 and 5
-	-	"	0,62	1,6	1,25	calculation of No 24 and 6
-	-	"	-	~0,26	~ 0,2	value on table 1 No 4
carton of double folded card board	Stülp box(chromo substitute card board water repellent, steam proof impreganted	Ultrafan (steam proof glued)	1,5	3,5	2,7	test
-	"	"	5,5	4,1	3,1	calculation of No 28 and 4
carton of double folded	-	"	2,6	6,9	5,23	[illegible]

31	-	-	Ultrafan(steam proof glued)	-	9,4	7,1	calculation of No 28 and 6
32	-	-	"	-	8,4	6,4	value on table 1
33	carton of double folded card board	Stülp box like No 29	Cuprephan lacquered on one side	1,4	3,7	2,9	test
34	-	"	"	6,0	4,5	3,4	calculation of No 33 and 4
35	carton of double folded card board	-	"	3,03	8,1	6,2	calculation of No 33 and 5
36	-	-	"	-	11,4	8,7	calculation of No 33 and 6
37	-	-	"	-	~9,0	~6,8	value on table 1
38	carton of double folded card board	Eco packings of cellulose carton, water proof intermediate lining of Alfol	-	0,32	0,96	0,73	Test (filling with plum[illegible] and 100 g sugar (800 c[illegible]
39	-	"	-	1,15	1,0	0,76	calculation of No 38 and 4
40	carton of double folded card board	Stülp box(chromo substitute card board 800 cm^3	cellophane AST. inside bag (800 cm^3	1,1	2,9	2,2	test
41	-	-	"	-	3,6	2,7	calculation of No 40 and 3
42	-	-	"	-	0,37	0,3	calculation of table 1
43	carton of double folded card board	Stülp box like No 40	inside bag of Cuprophan (glued with paraffine Oppanol	4,4	11,7	8,9	test
44	-	-	"	-	45,3	34,5	calculation of No 43 and 3
45	-	-	"	-	~37	~28	calculation on table 15a
46	carton of double folded card board	Stülp box like No 40	inside bag of parchment 2 sides impregnated with paraffine plastic	3,6	9,6	7,3	test
47	-	-	"	-	24,5	18,7	calculation of No 46 and 3
48	-	-	"	-	~22	~17	calculation on table No 7a
49	carton like 46	Stülp box like No 28	"	1,73	4,6	3,5	calculation of No 48

the C_d values can be calculated from the G-values $C_d = \frac{G}{100.365.24.3600.\Delta C}$, where $C = 1,4.10^{-6}$ [illegible] .03)(g/cm^3), $C_d = G.0,76.10^{-3}$.

Table 6.

Number of double foldings of packing materials.

(The same packing materials as indicated at table 2 belong to the numbers).

No	+ 20°C.			-15°C.		
	along	diagonal	middle	along	diagonal	middle
1 A	-	-	-[2]	1200	850	1025
4	-	-	-[2]	133	103	118
7	1320	1180	1250	655	378	517
3	16432	9393	12913	3755	1846	2751
14	556	280	418	465	268	367
16	151	6	78	73	8	40
17	1200	275	738	700	16	361
19	1200	146	673	465	24	245
22	553	202	372	231	19	125
25	462	225	345	69	67	68
27	329	95	212	5	2	4
28	1200	1200	1200	36	14	25

2) The testing is done with Schopper's apparatus, elasticity 1000 g, directions DIN DVM 3412 IV. Air condition +20° and 65 % relative moisture as well as -15° and 70 % relative moisture.

1) At 20° too great expansion.

Appendix IX

Instructions For The Production of High Quality Dehydrated Vegetables.

(Translation of a statement issued by the Instituts für Lebensmittelforschung, Munich, 11 July 1945).

1. Only high quality fresh vegetables yield good dehydrated products The idea that second rate vegetables are suited for dehydration has caused unfavorable reaction and dehydrated vegetables

2. Some vegetables as cabbage, beans, kolrabi, winter cabbage, cabbage (curly), celery and potatoes must be blanched. Other vegetables such as mushrooms, red cabbage, parsley, dill and onions are not to be blanched.

3. The correct blanching time depends upon the kind of vegetable, shape and thickness of the pieces,

Cabbage	needs	a	blanching	time	of	60-100	seconds
peas	need	" "	"	"	"	40- 80	"
beans	"	"	"	"	"	90	"
kolrabe	needs	"	"	"	"	150	"
winter cabbage	"		"	"	"	40	"
and cabbage (curly)							
celery	needs	a	"	"	"	90-150	"
potatoes	need	"	"	"	"	100	"

Blanching is done in boiling water, thickness of the slices 3 mm. They must be taken in such quantities that the water remains boiling.

Overblanching diminishes the nutrient substance of the vegetables besides having an influence on the taste. This is the reason why the blanching kettles must be emptied as soon as possible after blanching has taken place.

4. The blanched products must be put hot in the dehydrators if possible. The product is to be cooled only if no continuous apparatus is available Then the blanched vegetables must remain in the cooling water only for so long a time as is absolutely necessary to lower the temperature.

5. The most favorable temperature for dehydration of all kinds of vegetables is between 55-60° C. The dehydration temperature of potatoes must not exceed 70°, the dehydration temperature of kolrabi and red cabbage not exceed 40° C. Seventy-five degrees is the limit of dehydration temperature for all dehydrated vegetables, the good taste of the products already being strongly influenced at this temperature. The specification of the temperature indicates, that <u>in no part</u> of the dehydrator the temperatures are allowed to exceed the limits, an exception being only the inlet.

After dehydration the water content of the dehydrated vegetables must not be over 10 %, mushrooms, spinach and carrots must have a water dontent even under 5 %.

6. The finished products have to be packaged immediately if no tin drums (which can be hermetically closed) are available.for storage.

7. The maintenance of this low water content is decisive for the quality of dehydrated vegetables after prolonged storage. This is the reason why dehydrated vegetables must be packed very thoroughly and never ought to be stored in moist rooms (as cellars or kitchens) nor hot rooms such as garrets.

The best materials for packaging of the dehydrated vegetables foils (Kunststoffolie and laminated aluminum foil) - for sale to factory kitchens and hotels; also could be used bags made of weather-proof Zellglass or Duplo; a (large) container for building small untreated cartons. Less vapor-proof packaging paper could be allowed only with peas and beans.

<u>Note:</u> Carefully produced, dehydrated vegetables stored cool and dry are hardly to be distinguished from fresh vegetables with regard to quality. Therefore, dehydrated vegetables are considered to be a high quality foodstuff.

Munich, 11 July 1945

Institution for Food Research, Munich.

Appendix X

Dehycrated Meat by Dr. R. Heiss

Institute of Lebensmittel Munich 28.6.43

Translation and condensation

Because of transport it is desirable to concentrate protein- and carbohydrate-containing substances, especially the substance of high water content such as meat and vegetables, etc.

In the case of meat, there were difficulties inasmuch as the dehydration of plain meat should be of little interest. This is due to the fact that very good meat products already exist in the form of dry sausages and cured bacon which have high nutritive value (up to 700 Cal. per 100 g). Because of their natural acceptance, these products are superior to plain dehydrated beef. Although army units had at one time sufficient supplies of cured bacon, dried sausage, etc., the situation grew worse as the stocks of pigs were reduced and at the same time the supply of tin cans was also reduced. This made it necessary to resort to dehydration on an increased scale in order to furnish sufficient food to the troops.

Before the supreme command of the army could start research to develop dehydrated meats in large pieces, it was necessary to consider methods already known. Dried beef sold commercially exists in large pieces but it is high in water content and is tough. If during storage, additional drying takes place the meat becomes so hard that it can hardly be chewed. If protected from further drying by means of a covering or protective coating this product might prove a substitute in climates not conducive to execessive thirsts. Bündner meat is made in Switzerland but its manufacture is so slow and laborious that huge plants would be required. Besides, the fat becomes of very poor flavor and the product is pickled and slightly salty. South American dried meat is produced by drying in the sun and it is then ground to a powder and mixed with fat. This mixture is known as perimcan. It is important in Brazil. It is similar to what is known in Germany as Fartwurst.

Toughness is a problem common to nearly all dried meat products. This includes samples from factories submitting vacuum dried products. One product was refused because its essential contents were gristle. Even in Eastern Germany where the dry climate is favorable, successful dehydration has not been accomplished.

Better prospects seemed to exist for the suggestion of the North German Oil Mill Works who suggested the vacuum dried meat be mixed with rape seed oil. A similar process seems to have been followed by Julius Meine of Vienna. All of these suggestions only partially solved the problem.

There are two problems

1. To avoid toughness
2. To handle meat containing a high per centage of fat.

The production of meat in pieces is desirable. Powder is not acceptable. Meat is not of uniform composition and there are many discouraging discrepancies to be reckoned with. The following factors are important.

1. The degree of maturity of the meast.
2. Drying temperature.
3. Drying speed.
4. Degree of drying.
5. Mechanical and chemical pretreatment before drying.
6. Time of swelling and water temp.
7. Nature of packing material.
8. Condition of storing.

All of the factors had to studied indepently. Slices 6 to 8 mm thickness were dried in order to study the above factors.

The influence of the pretreatment proved to be of no importance. Even beef dried only to a water content of 20% and stored at -1° C. for 3 weeks became tough and assumed a stale flavor. If the flesh is too fresh the flavor is sweet after drying but soon becomes stale. Prestoring for long periods of time gives bad color to the finished product. 4 to 6 days ageing before drying seems to be the most desirable - the same as has been found for fresh meat.

The drying temperature provided a great surprise. The original assumption that a low drying temperature would be best proved to be wrong. A drying temperature of 40°-50°C. seems to be the best. A temperature of 30° C in the vacuum chamber was considerably less satisfactory whereas a temperature of 60° C. was almost as good as 50° C. Increasing the temp. to 100° C. did not produce further toughness. It may be that the influence of higher drying temperatures was compensated by a reduction of time. The 30° C. drying required 4 times as long as was needed at 50° C. All experiments requiring long drying time (over several days) caused the meat to becoome tough. The vacuum dryer was of no benefit with respect to flavor and thoughness. No special drying chambers are needed in Eastern Germany. The degree of drying was decisive., down to a water content of 30% tenderness could be maintained. Below this level, and especially between 10 and 20% the meat became tough. It therefore does not seem possible to produce a tender product with a water content low enough for suitable stability.

Better results were obtained by boiling the flesh for 45 minutes before drying and it was also possible to bring the water content down to 10% without doughening.

Better still was precooking in an autoclave for one hour at one atmosphere increased pressure. A slightly cooked flavor is developed in the autoclave but it is not objectionable. It is the disadvantage of this process that fat and other nutritive agents are extracted. In order not to lose these substances they must be thickened separately thereby necessitating added machinery. The process has the advantage whereby slightly thicker slices may be dried. Pounding of the flesh prior to drying proved of no value.

In another series of trials, the pH value of the meat was varied between 4 and 9. After 2 days pre treatment in N/3 acetic acid and drying at 50° C for 15 to 24 hours, the meat was tender at a water content between 10 and 15%, but tough if below 10 %. The flavor was sour and not at all like meat. Longer acid treatment gave increased tenderness but resulted in unsatisfactory flavor. By boiling acidified meat with sodium bicarbonate, the sourness was eliminated but the flavor was flat but somewhat similar to fresh meat. Treatment with N/12 and N/6 acetic acid did not influence toughness. A pretreatment with lactic acid

and with sodium acetate-acetic acid mixture had to be eliminated because of poor flavor.

A short soaking of the dry meat prior to boiling gave only little improvement with respect to consistency but on the other hand flattened the flavor.

<u>Summary</u>

High drying temperatures are not as dangerous as assumed.

Pretreatment is recommended but it is pointed out that much nutrient is lost by this method.

The best method seems to be the manufacture a semi-preserve for which the meat is dried to a water content of 20 - 25% at 45° C. and is subsequently canned. This saves at least 50% of the can metal.

Through the addition of a stable fat, the fiber is more easily chewed and, moreover, the caloric value is increased. As an alternative the meat may be treated with strong acetic acid, washed, and dried at 40° C. to a water content of 10%, compressed, and coated with a protective coating.

Appendix XI

Part A

Market regulations for Slaughter Cattle and Meat.

A I. Market regulation, supply of goods and shipping.

1. Market regulation

These agreements are based upon the market regulation of the Central Union of German Cattle Trade as stated every year in regulation No. 1 of this Union.

2. Supply of cattle and meat for provisions

In agreement with the requirements of the Wehrmacht the necessary cattle or meat is supplied by the Central Union of German Cattle Trade to slaughter-cattle markets, distribution organizations, collecting points or shipping points.

3. Supply to army contractors.

(1) For supply to the Wehrmacht the distribution organizations provide the slaughter houses with quantities for which an official demand is not required. The Wehrmacht is supplied by the slaughter-houses with the quantities demanded. Every supply must be acknowledged by a certificate of order or supply and on the bill.

(2) The provisioners will receive the ration cards from the Wehrmacht 1 to 2 days after the fixed time has expired. In these cards the supplies which have been effectuated are to be recognized. The provisioner must deliver them to the distribution organizations.

(3) The provisioners must deliver the recognized and stamped certificates of order or supply to the distribution organizations after the time fixed on these certificates. The Cattle Trade Unions are enabled to fix other times of delivery. Based upon the verification of these papers the definite account is put according to the allotted share.

(4) Inasmuch as the army-contractors for provisioning of garrisons do not slaughter themselves and meat is allotted to them in halves or in whole animals, they are entitled to demand the entrails, bowels, blood etc.

4. Shipping and designation of cattle

(1) Forwarding.

In order to avoid unnecessary losses during transport the following regulations must be

observed when forwarding cattle per railway, motor van or other conveyance:

a) Over-fed animals must not be shipped. Also feeding with constipating or binding foods is to be considered as an over-feeding. The cattle must not be fed with concentrated food. Food, especially potatoes, turnips and the like must not be transported in the same truck unless feeding is necessary for longer provisioning transports.

b) When forwarding hogs in covered railway carriages (G-trucks) 2 door railings are to be put within the time from May 1st to September 30th if more than half of the maximum admitted are loaded according to (2) b of this paragraph. In all other cases as well as with the other kinds of cattle 1 or 2 door railings are to be put depending on the number of cattle All air-valves are to be opened. During the time from October 1st to April 30th two open diametral air-valves will suffice and, depending on the number of cattle and the weather, one or no door rail is put.

c) Oxen, calves, hogs and sheep are to be separated from each other by means of durable separating railings. Male and female animals which already have reached sexual maturity, must also be separated from each other by durable separating railings. Hogs, calves and sheep are not allowed to be tied fast nor tethered.

d) Cows with suckling calves must be separated from the other cattle by railings.

e) The bottoms of the trucks must be provided with a layer of sand, sand with straw, saw dust and the like in order to avoid accidents.

f) If any residues are left in the truck of artificial manure or chemicals or other noxious substances the forwarder must remove them before shipping the animals.

g) Forwarding of sick or delicate animals is prohibited, the animals to be received must be in a state of transportability.

(2) <u>Transport</u>

a) On the transport the pigs, calves and sheep must be able to lie down in the truck, all at the same time.

b) For the transport of hogs in railway carriages the following numbers of cattle must not be exceeded:

Average weight of the pigs	One deck truck (G-truck) bottom surface sq.m.		Double deck truck (V-truck) Space of one deck sq.m.	
more than 2oo kg	18	21	18.5	21.5
	22	25	42	48
about 15o kg	26	3o	48	54
" 125 kg	32 (34)	36 (4o)	6o (68)	66 (8o)
" 1oo kg	35 (4o)	4o (45)	66 (8o)	72 (9o)
" 75 kg	5o (55)	6o (66)	96 (1o4)	1o8 (118)

The figures put within brackets are valid for the time from October 1st to April 15th.

c) For the transport of oxen, calves and sheep in railway-trucks the following numbers of cattle must not be exceeded:

(a) Large cattle	Truck 18 sq.m.	truck 21 sq.m.
more than 7oo kg	9	12
about 6oo kg	11	13
" 5oo kg	12	14
" 4oo kg	14	16
(b) Young cattle		
about 3oo kg	16-18	18-2o
" 2oo kg	18-2o	2o-22

(c) Calves and sheep.
not more than 3 animals per 1 sq.m. of loading space.

d) If trucks with another bottom surface are to be disposed of the maximum capacity of animals is to be calculated from the average surface required for one animal according to the figures above.

e) The maxima prescribed in the paragraphs b) and c) are also valid for the loading space of all other vehicles.

f) All other regulations to be observed when forwarding slaughter cattle (for instance the German Railway Tariff for animals, the laws of prevention of cruelty to animals, regulation of Veterinary Police and the like) are not affected.

(3) Designation

(a) In order to avoid defacement of the hide, designation of hogs by brand, puncture and scratch marks is only allowed on the head a handbreadth from the necks edge.

(b) Designation of calves by cutting the hair is prohibited on the whole body except the head.

A II. Slaughter-animals, classes of slaughtering value and slaughtering yield.

1. Slaughter-animals.

(1) Slaughter-cattle are considered as: beef, hogs, calves and sheep destined for slaughter.

(2) Considered as beef: oxen, bulls, heifers and cows.
(3) Considered as hogs: hogs including sows, boats, runners (hogs of about 1 year of age), young pigs. Hogs of more than 5o kg are also considered as slaughter-pigs although they are not destined for immediate slaughter. Exception is only made with regard to the hogs used exclusively for breeding purposes.
(4) As calves there are considered oxen of less than 1 25 kg as well as all unsexed calves. On the slaughter-cattle markets and at the distribution organisations the market commissioners and the heads of the distribution organisations are entitled to signify as calves animals of more than 125 kg and as oxen animals of less than 125 kg.
(5) As sheep there are considered: lambs, wethers and sheep.
(6) As meat in the sense of these regulations there are considered all kinds of fresh or salt meat of ocen, hogs, calves and sheep which is suitable as human food. The designation "meat" envolves also the entrails including the blood of these animals.

2. <u>Classes of slaughtering value.</u>

There are the following classes of slaughtering value:

<u>1. Neat</u>

Oxen:
AA) "Show" cattle
A) full-fleshy, well-fattened of highest slaughtering value
B) other full-fleshy
C) fleshy
D) little fed

Bulls:
AA) Fat show cattle
A) young, full-fleshy of highest slaughtering value
B) other full-fleshy or well-fattened
C) fleshy
D) little fed

Cows:
AA) Fat show cattle
A) young, full-fleshy of highest slaughtering value
B) other full-fleshy or well-fattened
C) fleshy
D) little fed

Female calves:
AA) Fat show cattle
A) full-fleshy. well-fattened of highest slaughtering value
B) full-fleshy
C) fleshy
D) little fed.

2. Hogs.

a) Hogs of 150 kg and more of live weight
b1) Hogs of 135 kg to 149.5 kg of live weight
b2) Hogs of 120 kg to 134.5 kg of live weight
c) Hogs of 100 kg to 119,5 kg of live weight
d) Hogs of 80 kg to 99.5 kg of live weight
e) Hogs of 60 kg to 79.5 kg of live weight
f) Hogs of less than 60 kg.
g1) fat bacon sows
g2) other sows
h) male hogs
i) Altschneider

3. Calves

Special class:
Unsexed best fattened
Other calves:
A) Best fattened and suckling calves
B) Medium fattened and suckling calves
C) Suckling calves of low value
D) Calves of lower value

4. Sheep

A) Lambs and wethers:
   a) best fattened lambs and best young fattened wethers and best young fattened rams.
   b) Medium fattened lambs, relatively old fattened wethers and relatively old fattened rams.
   c) Lambs, wethers and rams of lower value.

B) Sheep:
   a) Best sheep
   b) Medium sheep
   c) Sheep of lower value.

Judgment to what class of slaughter-value an animal corresponds, is made by special committees on the slaughter-cattle markets. It is incumbant upon the market commissioners to survey the judgment of these committees and alter them if necessary.

3. Determination of the oxen's age.

It is of special imprtance to determine the age of large cattle. As a clue for the determination of age serves the dentition in oxen as well as the horns in cows:

By irregulatities in the shedding of teeth errors in the determination of age up to about one year may occur.

The following summary shows how to determine the age of large cattle:

1. Up to 1 year of age

   Shedding of teeth has not yet taken place. The underjaw of the ox shows the milk incisors.

2. About 1 1/2 to 2 years of age

Of the eight incisors the two middle ones (also designated as tongs) will be shed.

3. About 2 1/2 to 2 3/4 years of age.

One year later the two inner middle teeth will be shed.

4. About 3 1/2 to 3 3/4 years of age.

The two exterior middle teeth will be shed at an age of about 3 1/2 years.

5. About 4 1/2 years of age.

Shedding of the canine teeth is accomplished at an age of about 4 1/2 years.

The dentition is considered as accomplished at an age of about 5 years.

6. Cows of an age of 6 years andmore

It is possible to determine the age of a cow approximately by feeling the horn with one's hand and counting the number of the rings (horn rings). The number of horn rings + 2 = the age of a cow, a meat being admitted to breeding with about 2 years and being formed one horn ring with every calf. At higher ages the horn ring formation is no longer distinct and perceptible.

4. Slaughtering yiels.

Classification according to the slaughtering value is made with regard to the age and the quality of the animals and with regard to the slaughtering yields. As to quality and slaughtering yields the following directives are given:

a) Oxen

AA	Fat show cattle	6o % and more
A)	Full fleshy well fattened of highest slaughtering value	58 % and more
B)	other full-fleshy	about 55 %
C)	fleshy	" 5o %
D)	little fed	" 47 %

As f u l l f l e s h y well fattened oxen of highest slaughtering value are to be considered those which are of highest quality, not yet having been yoked, with low breastbone, fleshy ribs, broad full-fleshy loins and hind quarters muscular nearly all their length, not too fat; the weight being more than 55o kg. Cutting up at least to 58 %. The

quality is depending on the treatment and feeding of the animals. Age: 2-5 years. Animals fattened in the stable and those fattened on the pasture are equivalent. The yellow fat of the pasture-fattened oxen must not induce reductions of the quality.

O t h e r f u l l - f l e s h y oxen. This class envolves the best quality which ranks slightly behind the superior quality. The hinds may be a little less full than with A-animals. The slaughtering yield must not be lower than 54 %. Age: between 3 and 6 years.

F l e s h y oxen: These animals ought to butchered only to a reduced extent. This class is very inferior to the class of A- and B-animals. There is only little flesh and fat on these animals. Slaughtering yield about 5o%.

L i t t l e f e d oxen are of low value in every respect.

b) Bulls

AA)	Show bulls	6o % and more
A)	young full-fleshy of highest slaughtering value	58 % and more
B)	other full-fleshy	about 55 %
C)	fleshy	" 5o %
D)	little fed	" 45 %

Y o u n g f u l l - f l e s h y m a t u r e fattened bulls of highest slaughtering value must have a massy, full, unlaced and fleshy front rib, a broad and solid back, low breast, full, low legs, thick loin. The animals must not be fat, but slightly covered. Weight: 45o to 6oo kg. The slaughtering value must be more than 57 %. Age: 1 1/4 to 3 years. The bulls must still have one milk tooth in the incisors' dentition. The quality is depending on fattening the bulls when still young.

O t h e r f u l l - f l e s h y or well fattened bulls are of a lower slaughtering maturity. Slaughtering yield: up to 55 %.

F l e s h y bulls. They only reach a slaughtering yield of about 5o %.

L i t t l e f e d bulls are animals of low value with a slaughtering yield of about 45%.

.) Cows

AA)	Show cattle	58 % and more
A)	young full-fleshy of highest slaughtering value	about 57 %
B)	other full fleshy	" 53 %
C)	fleshy	" 49 %
D)	little fed	" 48 %

Cows having calved more than six times may not be designated as A u s s t i c h t i e r e (AA).

A - C o w s must be young, well fattened animals. Weight: 6oo - 8oo kg. Slaughtering yield about 57 %. Attention is to be paid to horn and teeth.

B - C o w s are also animals of high value. The slaughtering yield amounts to 53 %. B-cows generally means old cows which have calved often.

C - C o w s are older and not medium fleshy cows. In the most they are cut up to no more than 5o %.

D - C o w s: little fed, old, fleshless animals.

d) Heifers

AA)	Show cattle	6o % and more
A)	full-fleshy, well fattened of highest slaughtering value	about 6o %
B)	other full-fleshy	" 56 %
C)	fleshy	" 52 %
D)	little fed	" 48 %

Heifers are for the most equivalent to oxen and must be of the same quality as these animals.

e) Calves

	Special class, well fattened unsexed	about 71 %
A)	best fattened and suckling calves	" 63 %
B)	medium fattened and suckling calves	" 6o %
C)	suckling calves of low quality	" 55 %
D)	calves of low quality	" 5o %.

C a l v e s o f t h e s p e c i a l c l a s s : Fattened exclusively with unskimmed milk, abnormally strong leg formation, white mucous membranes hint at white flesh. White mucous membranes are the preliminary condition for ranking a calf into the special class. Slaughtering yield: 7o - 72 %.

Best f a t t e n e d a n d s u c k l i n g c a l v e s, as far as possible with white mucous membranes. Weight: 1oo - 125 kg. Slaughtering yield: 6o - 65 %. A-calves have still white flesh.

M e d i u m f a t t e n e d and s u c k l i n g c a l v e s are similar to the A-calves, reddish mucous membranes exclude them, however, from the A-class. Fatting is produced not excludingly with unskimmed milk. Weight: about 1oo kg. Slaughtering yield: about 6o%.

S u c k l i n g   c a l v e s   o f   l o w   q u a l i t y are early weaned, immature calves, about 4 weeks of age. Color of flesh: reddish. Weight: 60-75 kg, slaughtering yield: 53-58 %.

C a l v e s   o f   l o w   q u a l i t y are undeveloped animals up to 14 days of age. Flesh: reddish, watery and feeble. Weight: about 30 kg. Slaughtering yield: about 50 %.

f) Sheep

A) Lambs and wethers

a) best fatted lambs, best young fattened wetherc and best young fattened rams	50-55%
b) medium fattened lambs, older fattened wethers and older fattened rams	48-50%
c) lambs and wethers of lower value	45-48%

F a t t e n e d   l a m b s: Weight: 25-45 kg, milk dentition. Flesh tender and light. Slaughtering yield: 50 - 55 %. Age: 3-9 month. The animals must have been fed with unskimmed cowmilk and with concentrated food or they must have been fattened by pasture.

F a t t e n e d   w e t h e r: Older than the lamb. 2 yearling's teeth (yearling), with broad and very fast back. Weight up to 65 kg. Slaughtering yield 50-55 %. The flesh is darker and solid. Age: 9 to 23 months.

M e d i u m   f a t t e n e d   l a m b s and o l d e r   f a t t e n e d, mostly high-legged animals, unsufficiently fed; brought up without concentrated food. Weight: 45-50 kg. Slaughtering yield 48-50 %. Age up to 3 years.

L a m b s   and W e t h e r s of   l o w e r   v a l u e with inferior flesh, frail and emaciated.

B e s t   s h e e p, animals unsuitable to lamb production. Young March sheep; well fattened. Weight: 50-60 kg. Slaughtering yield 49-51 %. Meat for cooking. On an average more than 3 years.

M e d i u m   s h e e p, not so well fattened. Slaughtering yield 43 to 46 % (cooking meat).

S h e e p   of   l o w e r   q u a l i t y, unfattened, fleshless animals, Slaughtering yield: 35-40%. The flesh is not suitable as fresh meat.

g) Hogs

a) Hogs of a live weight of 150 kg and more, fat bacon hogs and full-fleshy hogs	about 85 %
b1) Hogs of a live weight of 135-149.5 kg	about 82 %

b2) Hogs of a live weight of 12o to 134.5 kg	about	8o %
c) Hogs of a live weight of 1oo to 119.5 kg	"	78 %
d) Hogs of a live weight of 8o to 99.5 kg	"	73 %
e) Hogs of a live weight of 6o to 79.5 kg	"	7o %
f) Hogs of a live weight of less then 6o kg	"	68 %
g1) fat bacon sows	"	82 %
g2) other sows	"	8o %
h) male hogs		
i) Altschneider		

a) -hogs: Fat bacon hogs and full-fleshy hogs, live weight and more. Slaughtering yield about 85 %. In the case of the bacon hog about 36% of the yield are fat. In the case of the full-fleshy hog (meat-hog) the portion of meat is great; relatively more meat than fat. Useful for preparation of smoked meats.

b1-hogs: Also here fat and meat types. Live weight 135 to 149.5 kg. Slaughtering yield about 82 %.

b2-hogs: Full-fleshy hogs. Live weight 125 to 134.5 kg. Slaughtering yield 8o %.

c-hogs: Full-fleshy hogs. Live weight 1oo to 119.5 kg. Slaughtering yield about 78 %. Meat-hog type especially suitable for fresh meat consumption.

d-hogs: Full-fleshy hogs. Live weight 8o-99 kg. Slaughtering yield about 73 %. Meat-hog.

e-hogs: Fleshy hogs, immature animals. Weight 6o to 79.5 kg. Chop-hogs. Slaughtering yield about 7o %.

f-hogs: Runners (pigs, one year of age), immature goods which must be sold. Weight: less than 6o kg. Slaughtering yield varying (about 65 %).

g1-hogs: Fat bacon sows. Weight 15o kg and considerably more. Slaughtering yield about 82 %. Meat reduced in quality. Application: Lard and durable goods.

g2-hogs: Other sows, of varying weight. Slaughtering yield about 8o %. Small quantity of fat. The meat's quality being reduced. Application: Durable goods.

h-hogs: Male hogs. Varying weight. Slaughtering yield also varying. To the meat adheres a disagreeable taste (urine). Possibly it may be used for lard and durable goods.

i-hogs: Altschneider, useful if very well fattened. Varying weight. Also the slaughtering yield is varying. Application: Lard and durable goods;

A III. Slaughtering, slaughtering rooms, inspection of cattle and meat, refrigerating.

1. Supply of the cattle.

(1) On slaughter-cattle markets and on slaughter-cattle yards the cattle to be sold must not be fed not watered within an interval of 12 hours before opening the market until its end.

(2) Slaughter-cattle which is conveyed from a distance less than 50 km to the place of the cattle market or cattle yard, must not be fed within 17 hours before opening the market, contrary to the prescriptions of § (1). If this kind of cattle is brought to the cattle market or cattle yard within 15 hours before the market is opened, this is to be designated according to more precise directions by the market's administration.

(3) Cattle which have been on the way during more than 24 hours without having been fed and which arrive within the interval between 12 and 9 hours before the opening of the market are allowed to get the half of the fixed daily food ration, contrary to the prescriptions of § (1).

(4) Cattle is considered empty of food if it
a) is normally fed and watered within three days before conveyance to a cattle market or slaughtering yard, or

b) if it has not been fed or watered within 12 hours before the beginning of the market without prejudice of the regulation mentioned in (2) and (3).

(5) Cattle which has been fed or watered before the beginning of the market deviating from the prescription in (4), is considered as being overfed. Cattle is also overfed if it has been fed with food materials constipating or difficult to digest.

(6) If cattle is brought in a cattle market or in a slaughtering yard which has been overfed, the purchaser is entitled to shorten the price according to the ascertained overweight caused by overfeeding. A claim to reduce the price is assumed to be agreed between seller and purchaser.

(7) In the case of selling oxen ~~and~~ pigs on cattle markets there may be calculated an addition for emptiness to the entrance weight on definite suppositions as are fixed every year by regulation No.1 of the main union of the German cattle trade. This addition depends

a) on the time of transportation in the case of oxen. It amounts for a transportation time of

from 24 to 3o	hours	to 3%	of the	entrance weight
" 31 to 5o	"	to 4%	of "	" "
above 5o	"	to 5%	of "	" "

b) on the distance from loading place to destination in the case of pigs. It amounts for distances from 3o1 to 45o km to 1%
" 451 to 8oo km to 2% and
above 8oo km to 3%.

The addition for emptiness is calculated as percent addition to the entrance weight ascertained at the place of destination. The ascertained entrance weight and the addition for emptiness should be based as selling weight, to the price calculation. If a higher class of slaughtering value is attained, in the case of pigs, by the selling weight than by the entrance weight, the price of the higher class of slaughtering value must be based to the sale.

2. Condition of stables.

The cattle destined to slaughter must be housed in airy and bright stables. The stables must be built in a roomy manner that the beasts do not stand too narrow and crowded, but have sufficient place for eating and for rest.

Pigs must be stabled in special boxes. They should have sufficient place and must not lie penned up. When stabling pigs it must be considered that pigs of different stables (different producers) are separated as far as possible. Otherwise the beasts will bite, they will not rest and will come to slaughtering in a hot state. Thereby the meat becomes unuseable for the manufacture of certain meat products.

3. Treatment of the animals before slaughtering.

Before slaughtering the animals must be inspected as it is prescribed by law. Only reposed beasts should be slaughtered. They are driven to the slaughtering place with the greatest caution and forbearance.

4. Condition of slaughtering rooms.

The following must be considered for private slaughtering houses (not municipal):

The slaughtering room must be large enough. Water necessary for cleaning purposes must be available in the room itself or in the neighbourhood. The height of the room shall at least amount to four meters. There must be good light in the room provided by a sufficient

number of windows. By window openings and ventilating-shafts, care must be taken to rapidly remove vapors and fumes. The slaughtering room must be separated by massive walls from the other rooms; the walls must be plastered with cement and painted, up to a height of at least 2 meters, with a light-shaded, not red, oil color, or it must be lined with tiles or at least covered with a washable cement plastering. The floor must be impervious to water and should not have boards; it must have a falling gradient. The removing of the waste water must be adjusted in such a way that there are not formed accumulations of blood etc. There must be strong bottom rings in order to hold larger animals. The room should not be used for working up meat . The rooms destined for working up meat should not be in immediate connection with the slaughtering room. Dogs, cats and flies etc. must be kept away. The solid slaughtering offals must be removed immediately after slaughtering, or gathered in a hole impermeable to water and equipped with an air tight cover. The offal should be covered with milk of lime until transport. If the windows of the slaughtering house look upon the street, they must be provided with opaque glass and adjusted so high that one cannot look into the rooms from the street. In order to protect against sunbeams there must be applied to the windows in question a blue protective coating.

5. <u>The slaughtering of the animals.</u>

The killing of the animals must be performed in an appropriate and experienced manner by trained butchers only. The professional clothing of the butchers intrusted with the slaughter should be clean and suitable.

(1) Oxen. The stunning is carried out according to the valid prescriptions. The animals are stuck immediately after stunning. Before stunning the animals are tied to a bottomring. The bulls should receive masks before stunning. The beasts must be cleanly stuck and allowed to bleed. Throat and trachea must not be injured. Care must be taken when skinning the animals. The hide shall not be damaged. Attention must be paid that the hide isnot soiled.
The animals must be cleanly cleaved. The bones os the spine must be uniformly distributed. No splinters of the bone shall be formed by the cleavage of the spine.

The slaughter must be carried out so cleanly that a washing (spraying) of the meat surface is not necessary. Soiled parts of meat are only sprayed with tap water in the case of

strong conta........ by the contents of stomach and intestines, blood etc. The use of wipers is not allowed.

The oxen must be quartered. They are divided at the seventh rib, so that at least six ribs remain in the fore quarter.

(2) Calves, wethers and sheeps are stunned by blow with the slaughter hammer or cudgel and stucked safely and rapidly. Skinning and cutting up in the same way as with oxen.

(3) Pigs are stunned according to the valid prescription. When sticking pigs, attention must be paid that the stitch is not too deep and that the trachea is not injured. Before treating with hot water the trachea is shut, e.g. by a clamp tp prevent the penetration of water into the lungs. Care must be taken when treating the pigs with hot water. Pigs are divided into two parts. When being carried the pigs must not be broken.

(4) Blood of the animals to be butchered. The blood obtained when killing oxen and pigs is collected in a clean container, it is stirred and then treated carefully. Losses of blood should be avoided. The blood of every animal is collected separately and only mixed with other blood quantities if it has been established that the killed animal did not have a disease making the blood unuseable for human food.

6. Inspection of cattle and meat.

The investigation of the animals before and after killing is performed according to the prescription of the meat inspection law of October 29th 194o (Reichsgesetzblatt I page 1463) and to the order on the execution of the meat inspection law, of November 1st 194o (Reichs-Mitteilungsblatt page 289) including prescription for performance.

Cattle and meat is inspected in order to ascertain the qualification of the meat and the organs. Thereby it is prevented that meat is brought to the market and to consumption which does not correspond with the prescriptions of the meat inspection law. The inspected meat and organs must be stamped. According to the degree of qualification there are the following different stamps:

1. Qualified meat.
   The inspected meat is marked by a round stamp if it is qualified. Only qualified meat must be taken or worked up for Wehrmacht purposes.

2. Meat of inferior quality.
   Meat of inferior quality, caused for instance by deviation of color, small, insufficient bleeding out and watery appearance, is signed by a square stamp containing a circle inside.

   Shamble meat.

3. Conditionally qualified meat.
   If there is an infectious disease, e.g. certain cases of tuberculosis, erysipelas, hog cholery, trichinae, the meat is signed by a square stamp, as far it is not unqualified.
   Shamble meat.

4. Unqualified. meat.
   Unqualified meat is marked by a triangular stamp.

5. Pigs are marked besides by a stamp in order to show that they have been examined for trichinae. The stamp has an oblong quadrangular form and contains the words: "Trichinenfrei" (free of trichinae).

The color of the stamps is blue. The stamps must contain the name or sign of the inspection district.

Meat imported from foreign countries is stamped by special stamps in red color.

Meat ordinarily inspected must have stamps on the following places:

With oxen:

1. on the side face of the neck
2. on the back side of the fore leg
3. on the shoulder
4. on the back in the kidney region
5. on the inner and
6. the outer face of the hind leg
7. on the tongue
8. on the exterior chewing muscle
9. on the liver (right and left liver lobe)
10. on the lung (each lobe of the lung)
11. on the heart.

With calves:

1. on the shoulder or on the back side of the fore leg
2. beside the kidney fat or on the back
3. on the breast
4. on the knuckle or on the under leg
5. on the exterior chewing muscle
6. on the liver (right and left lobe of the liver)
7. on the lung (each lobe of the lung)
8. on the heart.

With sheep:

1. on the neck
2. on the shoulder
3. on the back
4. on the inner face of the hind leg

5. on the exterior chewing muscle
6. on the liver
7. on the lung (each lobe of the lung)
8. on the heart

With pigs:
1. on the cheek
2. on the side face of the neck
3. on the shoulder
4. on the back
5. on the belly
6. on the exterior side of the hind leg
7. on the breast between the tenth and eleventh rib near the vertebral column
8. On the breast between the sixth and eighth rib near the breast bone.
9. on each lobe of lung
10. on the heart
11. on the liver.

Furthermore there must be applied stamp marks inside the abdominal and thoracic cavity, if pleura and peritoneum have been removed because of illness.

7. Slaughtering weight.

The slaughtering weight is the weight of the butchered animals; only the following parts may be separated:

(1) With oxen (with exception of calves)
  a) the hide
  b) the head behind the occipital bone and the first neck vertebra (Back of the neck)
  c) the feet in the lower link of the tarsus
  d) the organs and intestines of the abdominal, thoracic and pelvic cavity with the adhering fatty materials (Fat of heart, lung, intestines, gibbets or fat gut) with the exception of the kidneys and the kidney fat and pudenda fat.
  e) the blood vessels lying at the vertebra column and in the forepart of the thoracic cavity and the adhering tissues including the trachea and the sinewy parts of the diaphragm.
  f) the spinal cord
  g) with male oxen the genitals with exception of the sac fat
  h) with cows or heifers being pregnant more than half of the time: the udder.

(2) With calves:
the hide, the head, the feet, the organs and viscera of the thoracic and abdominal cavity with exception of the kidneys and the fat thereof, the navel, with male calves the genitals.

(3) With pigs:
the organs and viscera of the thoracic, abdominal and pelvic cavity, and the tongue, trachea and throat, with exception of the kidneys and the fat (skin-fat of the belly, and the inward fat along the sides),
with male pigs the external genitals.

(4) With sheep:
The hide, the head, the feet, the organs and viscera, the genitals, all these parts in the same manner as with oxen.

The parts of the animal not mentioned in numbers (1) to (4) being objected to during the inspection of meat, are calculated to the slaughtering weight.

The meat must be weighed in a cooled state. The meat is cool if it has been kept after killing for at least 12 hours in a cooling room or pre-cooling room or in another wellventilated room.

When selling meat not cool, the seller is obliged to draw off from the ascertained weight

2% with beef, veal and mutton
1.5% with pork.

The weight obtained after drawing off is based for the price calculation. The selling of meat not cooled is only admissible with permission of the market authority.

8. Cooling.

After killing the animals must be freely hung in the fresh air or in the pre-cooling room (from +6°C to +8°C) that the warmth of body may escape. After being thoroughly cooled the animals are brought in a room cooled corresponding with the season (from +0° C to +2°C) and kept there for at least 12 hours.

If it is hot weather the meat must not be brought, immediately after killing, in cooling rooms of from 0 to 2° C because then the exterior meat parts cool too rapidly, while the interior parts do not cool, the meat becomes stuffy and unuseful. The meat must rather be pre-cooled for a sufficient time. With heavy animals (e.g. bulls) the fore blades should be cut open for better cooling.

A. IV. Meat, meat qualities and pieces of meat.

1. Meat.

Meat according to these conditions is all fresh, slightly salted, salted and frozen meat of oxen, pigs, calves and sheep suited

for consumption by men according to the prescriptions of the meat inspection law. Meat for cooking and frying purposes must be taken from such animals only that correspond with the prescriptions on living cattle given above.

Fresh meat of rams, male hogs, "Altschneiders" "Binnen- and Spitzeber" of breed sows as well as of oxen being slightly measled, made qualified for consumption by keeping in cooling or refrigeration rooms for a longer time, must not be furnished and taken.

In the sense of these furnishing conditions there must not be considered as meat:

(1) in oxen: the head, the bloody neck cut, the udder of cows and heifers, the fore legs - including the fore tarses - and the hind leg downwards the hock,

(2) in calves: the head, the bloody neck cut and the legs in the same way as with oxen,

(3) in sheep: the head, the bloody neck cut, and the legs (as with oxen) with ewes also the udder,

(4) in pigs: head and cheeks, the bloody neck cut and the back fat and the skin fat of the belly,

(5) in all animals the viscera, stomach, spleen, gibbets, fresh blood as well as special bone additions, if they shall be calculated to the weight of the meat.

The meat and the organ parts must be examined according to the prescriptions of the cattle and meat inspection law. The examination is proved by the necessary stamping.

2. Meat qualities (for cooking and frying purposes.)

Meat of the quality class I must be furnished. That means cattle of the slaughtering value classes AA/A/B (= quality class I) with oxen, calves and sheep, and with pigs the animals of the classes b^2 and c, perhaps d.

In exceptional cases there must be also taken, if minor qualities of cattle are driven to market, meat of the quality class II (Slaughtering value classes C of oxen, calves and sheep) and eventually also meat of the quality class III (slaughtering value class D of oxen, calves and sheep).

The meat of the quality classes I, II, III is marked by stamping I, II, III on the

oxen halves, calves and sheep.

3. Indications of good meat qualities.

(1) Beef shall have a deep red shade and the grateful smell of fresh meat. It must be grown through (marbled) at the loins, fore and middle ribs. When handling and cutting it must be firm and show shining cuts. It shall give way when pressed by finger, but the impressions shall soon be balanced. The beef fibers shall be fine and sappy. The fat or tallow shall be white or yellow white and rather solid and firm. The tallow shall small as it is characteristic for oxen tallow. The intermediate tissue of the muscles shall be white and filled with fat and the marrow of the bones shall be from pure white to yellowish red, stiff and crumbly.

(2) Veal shall have a pale red or greyish-white color, it shall be fine fibered, moderately firm, not grown trough by fat, but surrounded therewith. The fat of the veal must be soft and white. The kidneys must be surrounded by fat, the marrow of the bones shall be rosa-colored.

(3) Mutton shall be firm, tight, from light red to brick red and fine fibered. The meat shall not be grown through by fat (except the soft part of the belly), but it shall be surrounded, in the case of fattened animals, with solid tallow, especially in the under-skin and in the kidney region. The tallow shall be odorless, the marrow stiff and reddish.

(4) Pork shall be from pale to pink and grown through by fat.
The bacon grown on the meat shall have a middle degree of firmness and a pure white color. The meat must not be coarse-fibered, dark red or rough, and the small and taste not disagreable or penetrating. The marrow of bones shall be from white to pink. The back bacon shall have a thickness of at least 3 cm.

(5) The meat destined for consumption as fresh meat must be well cooled and hung. It must not be too old and before all not smeary. Meat externally treated with acetic acid is not to be refused.

4. Pieces of meat.

(1) Meat must be furnished, according to the choice of the purchaser, in the following pieces (cuts)

a) oxen in quarters
b) sheep and calves in whole animals
c) pigs in halves
d) beef (masting and stewing beef): tenderloin, roast beef, rump, "Kugel" (ball, i.e the parts corresponding with the thick flank and the buttock), round, blade bone.
e) beef (cooking beef): short rips, "Kamm" (upper part of the neck scrag), "Querrippe" (near the fore leg), breast, "Spannrippe", hock,
f) veal (roasting and stewing meat): hind knuckle, back, kidney region, scrag,
g) veal (cooking meat): hind leg, fore leg, breast with thin flank, scrag
h) mutton (roasting meat): leg of mutton, back, shoulder,
i) mutton (cooking meat): belly, shoulder, breast, neck,
k) pork (roasting meat): chop, shoulder, spare-rib, leg of pork,
l) pork (cooking meat): feet, belly, "Eisbein" (pickled pork trotters) shoulder, cheek, head with snout and ear.
m) salted beef.

For cooking there may be furnished the breast of well fattened animals of the quality class I. The meat shall not be extremely fat and must be mildly salted.

n) salted pork.

For cooking there may be furnished spare-rib shoulder, meagre belly meat, ribs, Eisbein. These pieces must be mildly salted, and there must be no objection as to smell and taste.

(2) Always whole quarters of oxen should be delivered, and in calves and sheep whole bodies or halves. As to the number of delivered halves of pigs there must be considered the allotment of pigs and the securing of sauage manufacture.

(3) The pieces of meat of one sort as named above may be comprized to one delivery notion and made uniform in price: for instance tenderloin, sirloin, rump, Kugel, round, shoulder may be bought together as roasting or stewing beef and there may be calculated an average price according to the local price prescriptions.

(4) Meat in the form of cut pieces must be furnished only with the grown bones.

Designation of the single pieces of the pig. (cp. the figures)

1: ham = leg of pork
2: chop
3: spare-rib
4: shoulder = blade
5: belly
6: Eisbein (pickled pork trotters)
7: back fat
8: shank (pettitoes or feet)
9: head with cheek
10: skin fat of the belly

Designation of the single pieces of the calf.

1: hind knuckles
2: back
3: shoulder
4: scrag with neck
5: breast with thin flank
6: hock.

Designation of the single pieces of the sheep.

1: back
2: leg of mutton
3: shoulder
4: breast with thin flank
5: neck
6: head

Designation of the single pieces of the ox.

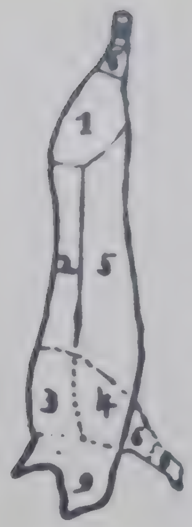
2a: Tenderloin
2b: sirloin

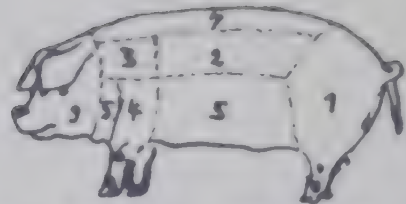
Stewing beef:

1a: rump
1b: "Kugel"
1c: round
4: shoulder

Cooking beef:

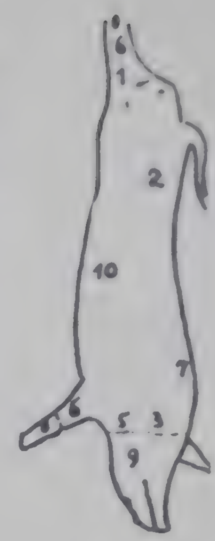
3: short ribs
5: scrag
6: "Querrippe"
7: breast
8: thin flank
9: hock.

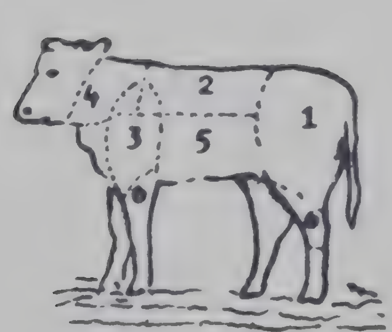


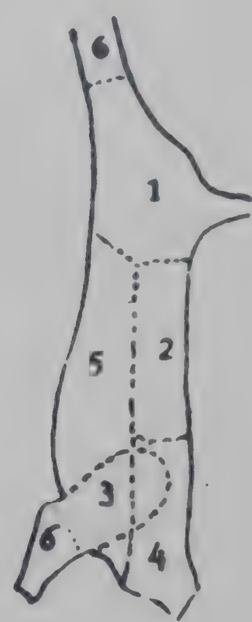


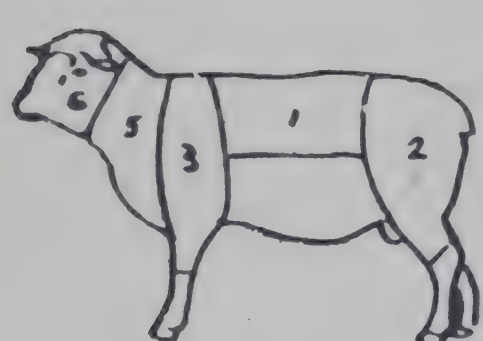
[illegible]

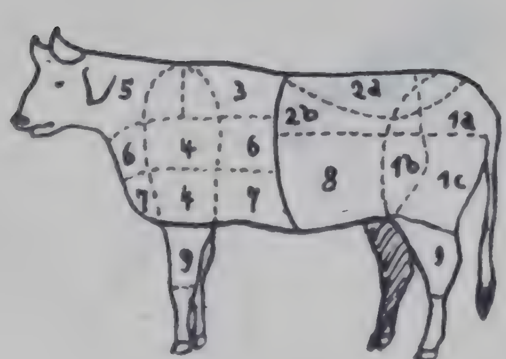
1: Schinken [illegible]
2: Kotelett [illegible]
3: Kamm Hals [illegible]
mit Schult.
4: Schulter Blatt.
5: Bauch
6 Eisbein Dickbein.
7: Rückenfett [illegible]
8: Spitzbein [illegible]
9: Kopf mit Backe.
10: [illegible] Flomen

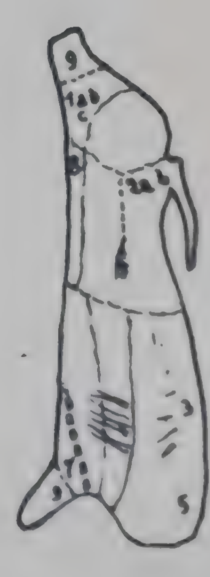












(5) If there are furnished single pieces of meat with grown bones for instance ham, chop, sirloin, ribs, the cut must be made as usual in the butcher's shop; ham with shank and tail does not correspond with the usual distribution. When furnishing such pieces there must not be made special additions of bones.

(6) With the following sorts of meat (which shall be only sold in special cases):
  a) beef: tenderloin, sirloin, beef cut small, fillet, breast salted or salted and cooked without bones,
  b) pork: fillet, collop.
  c) veal: fillet, cutlet,
  d) chopped meat: minced beef and pork,

there can be made an addition of bones - if they are usually sold without bones, - on requirement by the purchaser. The quantity of bones must correspond with the ration cards of the purchaser. The bones must be weighed separately and calculated according to the price of bones. The quantity of bones must not surpass more than

20% with pork
25% with beef
30% with veal

the quantity resulting from the ration cards of the purchaser.

(7) For boneless meat only mature animals must be used.

(8) Mutton is only to be furnished with well developed bones.

(9) Meat for hospitals must be chosen very carefully and delivered only in a good well hung state.

(10) The entrails (liver, heart, lung, farthing-bag, kidney, brain, udder and blood), if there available more than is needed for sausage manufacture, must be delivered to the troops on counting rate according to the order of the main union.

(11) The bones available free of ration cards must be offered to the troops proportionate to their share.

(12) The available broth- obtained in the cooking of meat i.e. without broth obtained in the cooking of sausages - belongs to the troops. Quantities not desired by the troops must be offered to the competent cattle economy union.

(13) The Wehrmacht contractor is responsible for the delivery of the slaughtering fats, which must be always performed according to the valid prescriptions of the main union of the German cattle economy.

A.V. Frozen meat.

For furnishing frozen beef and pork the same is true as for the furnishing of fresh killed meat. Frozen meat may be delivered in frozen or thawed state. But it must be thawed appropriately for delivery to troop or hospital kitchens.

A- VI. Dried meat.

Dried meat means meat (muscle meat) of warm-blooded animals the moisture of which has been removed by physical means (raised temperature with or without vacuum) to such an extent that a certain stability (durability) is attained. It must be designated as dried beef, pork, veal or mutton according to the animal used. Dried meat must correspond with the prescriptions given in part B VII of these conditions.

A VII. Game.

Game must be taken from hunted beasts, ordinarily treated immediately after killing (broken and disemboweled, hung airy, cool and appropriate, well cooled and hung, no stuffing of the abdominal cavity). There is to be refused meat of beasts driven to death, slain, drowned, succumbed, shot off in an ill state, very damaged by shooting or containing maggots, very poor, hot, old, and of ardent male animals. Fresh venison or vanison of cooling or refrigeration rooms must not be used without previous examination by the veterinary surgeon or inspection for trichinae (with wild boars, bears, dachshunds, foxes, beavers, martens, polecats) which must be proved by the furnisher. The prescriptions valid with game trade (meat inspection law, foodstuff law, law concerning hunting, game trade order etc.) must be considered, if not otherwise stated.

A VIII. Poultry.

Only healthy poultry may be used. It must be bled, killed as usual, plucked, prepared, appropriately stored and packed, not poor, fleshy, empty in craw and stomach and not too old. Frozen poultry must not show stains, it should not be dry or rancid or decomposed.

No poultry may be worked up without previous examination by the veterinary surgeon which must be proved by the furnisher. There must be considered the prescriptions valid with poultry trade, if not stated otherwise.

A. II. Emergency slaughter.

Meat of emergency slaughtering may be used for fresh meat supply and manufacture of fresh sausage. if stamped as being qualified according to the prescriptions of meat inspection.

Meat of emergency slaughtering must not be used for durable goods, preserved meat or sausage or a mixture thereof.

Part B.

Orders, manufacture, control and delivery.

B I. Orders and general requirements as to quality.

1. Orders.

Orders of the Wehrmacht, unless they are executed in its own saughter-houses, are given according to the following directions:

1) Orders for the provisions of the garrison are given by the respective store or victualling office to the slaughter houses under contract In case they are given large orders from the part of the Wehrmacht it is a matter of principle that they do not carry out any civil or other orders. If slaughter houses or meat dealers are to be appointed the furnishers to the Wehrmacht the respective "Innungsobermeister"(chief master of the corporation) or the respective "Bezirksfachgruppe Fleischwarenindustrie" (regional division of meat-industry) and the respective cattle union have to be asked for their opinion. The civil contingent of the suppliers to the Wehrmacht (slaughterers under contract) in suspended in agreement with the cattle union for the time during which delieveries are made to the Wehrmacht.

2) A contract must be made with all slaughterers supplying the Wehrmacht, for instance, accor-ding to the following scheme:

A g r e e m e n t :

between the chief of the Reich (army) repre-

sented by the "Wehrkreisverwaltung" (recruiting district administration ......)
acting for the latter the manager of the "Ersatz-Verpflegungsmagazin" (food supply magazine).................................
and

the meat provisions'factory (Butcher master) ....

represented by the owner ....

the following contract is made provided the agreement of the "Wehrkreisverwaltung".

§ 1.

The meat provisions'factory (the butcher master) .... binds itself to supply with meat and meat provisions starting from the .... a certain part, to be determined by the food supply magazine ...., of the troops of the army and air forces stationed at .... The "Ersatz-Verpflegungsmagazin" .... will ask in each particular case for the allowance of the Viehwirtschaftsverband ...., the Ernährungsamt (food supply Office) Department A (Kreisbauernschaft) .... and of the formation to be supplied with.

§ 2

The meat provisions'factory (the butcher master) .... binds itself for the duration of this contract not to make any other deliveries of meat or meat articles than those ordered by the Ersatzverpflegungs-Magazin ...... to be made to the formation concerned.

On account of this renunciation the meat provisions'factory (the butcher master)........ cannot make any claim to the chief of the Reich (army).

§ 3

The quantities of meat and meat articles to be supplied are communicated for each ration-period in advance by the Ersatz-Verpflegungsmagazin ... . to the "Viehwirtschaftsverband (Ernährungsamt)" .... which orders the "Marktbeauftragten des Schlachtviehgroßmarktes" (market commissioner of the large-scale slaughter cattle market) .... to allot the necessary cattle to the undertaker.

Unexpected difficulties in the supply should be communicated to the "Ersatz-Verpflegungsmagazin" .... which will give redress.

§ 4

The meat provisions'factory (the butcher master) .... is bound to meet the wishes of the troops for a certain kind of meat or sausage in so far as the situation of the market and the material at disposal allow of it.

§ 5

The dates for reception and delivery, respectively, for meat and meat articles have to be agreed upon by the manufacturer and the troops.

The manufacturer is, however, bound to deliver meat and meat articles without regard to the working time of his factory i.e. on Saturday afternoon or on Sundays and legal festival days if this should be necessary in exceptional emergency cases. The meat provisions factory (butcher master) .... if possible, has to be informed thereof in due time.

§ 6

The quantities required by the troops by means of order sheets must be delivered against delivery sheets. The ration ticket to be furnished by the troops at the end of the ration period must show the deliveries received. A delivery in excess of that indicated on the ration ticket may not take place.

Arbitrary changes of the ration tickets made either by the troop or the meat provisions factory (butcher master) .... are liable to be punished since a ration ticket is a document.

§ 7

The different kinds of sausage are prepared according to the recipes established for the Wehrmacht. The recipes represent <u>minimum requirements</u> as to the qualities of the sausages.

§ 8

For the sake of inspection and control of the factory the firm binds itself to keep a warehouse book, a fabrication book and a test book.

In case additional raw products for the manufacture of sausages are furnished from the part of the Wehrmacht, these have to be indicated separately.

§ 9

The prices are indicated in the list attached hereto. They are built up on the circular letter 9/40 of the "Reichskommissar für die Preisbildung" (Reich-commissioner for the fixation of prices) and on the special regulations thereto. The prices are for delivery of the goods free kitchen or free factory and are binding for both parties.

Inso far as other terms have been stiputated these have to be considered.

§ 10

The stiputations of the Wehrmacht for the delivery of slaughter cattle, meat, meat articles and sausage have been accepted by the firm ....

§ 11

The "Ersatz-Verpflegungsmagazin" .... or persons authorised by it or representatives of its superior offices are entitled at any time to inspect and to control from the economic point of view the meat provisions' factory (the butcher master's plant ....

§ 12

Both parties may annul this contract the first day of each month by giving a quarter's notice.

The "Ersatz-Verpflegungsmagazin" .... is entitled to annul the contract without period of notice if meat or meat provisions are no longer required for the region fo the garrison .... or if the manufacturer has severely infringed in some way or other the obligations arising out of the contract.

This contract ceases without notice if the premises underlying § 1 of the contract do no longer exist.

§ 13

The meat provisions'factory (the butcher master) .... is bound to the slaughter cattle market regulations also as regards the deliveries to the troops.

§ 14

The "Ersatz-Verpflegungsmagazin" .... has to be informed about divergences between the troop and the manufacturer. If an agreement cannot be reached or if other controversial points arise out of this contract, the decision of the "Wehrkreisleitung" .... is binding.

Legal domicile ....

§ 15

This contract enters into force on the "................ "Ersatz-Verpflegungs-magazin"

.... , ...194..
Oberstabsintendant

Approved
W.V.

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3) Logistics' food is prepared by meat provisions'factories and plants of equal kind. Except for orders of the Navy, these plants receive the orders for the preparation and delivery from the respective Reichsstelle (Reichsstelle für Tiere and tierische Erzeugnisse, Reichsstelle für Eier, Zentralhandelsgesellschaft Obst etc.) (Reich Office for animals and animal products, Reich-Office for eggs, central trading company for fruit etc.) in accord with the OKH/VA/V3. The quantity to be ordered and the number of the factories will be fixed by the respective Reich-Office in accordance with the kind and quantity of production ordered in each case by OKH/VA/V3.

2) Requirements as to quality.

1) All deliveries of fresh meat, frozen meat and dried meat, sausage and meat preparations as well as of the preserves mentioned in these stipulations have to be made in strict observation of the prescriptions of paragraphs A-F relating to quality and manner of preparation.

2) Prior to being delivered or worked up, meat and fat (with exception of meat to be worked up in the warm state) must be well cooled; the meat must have a healthy fresh color, the odor characteristic of fresh meat and must be distinguished by solidity, formness, suppleness and great fineness of fiber; it must not be flabby, dirty, smeary or sticky;
it must not be older than three days and (apart from exceptional cases) it must be worked up without any chemical addition.

3) All dirty or otherwise damaged parts of the meat are to be cut out; they must not be used for the preparation of supplies to the Wehrmacht. Merely to wash the dirty meat does not suffice to make it suitable for use.

4) As a matter of principle, there must only be used natural spices, i.e.:
   a) home-grown spices:
      onions, garlic, parsley, caraway, majoram, thyme, summer savory, peppergrass.
   b) spices from abroad:
      pepper, Cayenne pepper, cloves, nutmeg, pimento, ginger, cinnamon, capers, cardamon, pistachio.

   The spices must be free from dirt and dust.

   Spices bought in the pulverized state are often adulterated and mixed with vegetable powders of minor kind. If required in large quantities, the spices shall be pulverized in the own plant.

   Commercial common salt, low in chlorine, shall be used. The salt must have a pure white color and be entirely dry.

   Nitrite pickling salt, prescribed for use, must comply with the provisions of the law concerning the use of salts of nitrous acids for foodstuffs (Nitrite-Law) of June 19, 1934 (RGRl. I page 513).

   Artificial spices may only be used if it is impossible to procure natural spices and only with the permission of the Supreme Headquarters. As a matter of principle, this permission is at present considered as given for the supplies to the garrison regions.

5) Guts, spices, cases, wood shavings, tins, wire, oil as well as all materials for the fabrication and the dispatch must be procured by the manufacturer according to the regulations in force.

6) The quality of the raw materials for mixed preserves has, furthermore, to comply with the special provisions of parts B VIII, 1 and F of the said regulations.

3) Declaration regarding taxes.

During war time the manufacturer is relieved from the necessity of furnishing a certificate from the part of the board of finances that gis taxes have been regularly paid.

4) Notice to the personnel.

The contents of these stipulations, asfar as they concern the satisfactory carrying out of the order with regard to the composition of the various meat and sausage provisions or preserves, have to be made known to the personnel in appropriate form on the "blackboard" and countersigned by the "Betriebszellenobmann" (leader of the workers'union of

the factory). The notice has to remain on the black-board for the time of supply to the Wehrmacht.

5) Acceptance of these conditions.

With the offer to the Wehrmacht and with the return of a signed copy of the final sheet, respectively, the firm fully and with legal obligation accepts the conditions of the Wehrmacht so as if they were given in detail on the final sheet or on another confirmation of order of the Wehrmacht.

6) Taxes and duties.

1) Any fees for stamps affixed to documents will be borne by halves by both contracting parties.

2) All other expenses, charges, fees, duties etc. have to be paid by the manufacturer.

7) Revocation of the contract.

The Wehrmacht cancels the contract
1) if the manufacturer promises, offers or grants advantages of any kind to persons which from the part of the Wehrmacht have been ordered to conclude or to carry out the contract or to persons related to them. It is immaterial whether the advantages are promised, offered or granted directly or in the interest of the beforementioned persons to their relations or in the interest of the one or the other to a third person.

The Wehrmacht has the same right if a leading person in the firm (for instance, a member of the board of directors, as director, a manager, a member of the supervisory board, a procurist, the head of a department or of a branch establishment) or a person appointed as representative of the firm commits an action mentioned in the preceding paragraph or if such an action is commited by another person acting for the manufacturer with his knowledge or with the knowledge of one of the persons above mentioned.

2) in case of objections to the supply,

3) in cases of higher power.

8) Legal domicile:

1) Domicile of the respective "Wehrkreisverwaltung" (Marine-Intendantur) recruiting district Administration).

2) Additional conditions or alterations of the stipulations for delivery and terms for payment must be confirmed in writing in order to be valid.

B. II. Fabrication rooms, implements and personnel.

1) Fabrication rooms.

1) The fabrication rooms must be high, airy and light; they must be thoroughly aerated and cleaned regularly at the beginning and at the end of the working hours. The rooms for storing the meat must be cool, airy, large and dry. The walls must be provided up to 2 m height with tiles or a special coating (if required, with a smooth, washable cement-plaster) so that they can be washed off at any time. In order to avoid an accumulation of vermin and to reduce the action of the sun-beams and the heat the windows of the working-rooms have, if required, to be coated with a protective layer.

2) If the walls are not provided with tiles or a washable coating the tables must not stand against the walls.

3) In the rooms for meat - cooling rooms - only one piece of meat may hang on each hook so that it may well be cooled. The meat must not be in touch with another piece of meat or with the wall.

4) In the factory sufficient clean washing facilities and closets must be available, Clean towels or hot-air-driers, soap, nail brushes and toilet paper must always be at disposal. Water which has been used is not allowed to stand. The toilets must not be in direct connection with the rooms in which meat is worked up. They must be at least 6 m from the room in which meat is worked up. By notices in the toilets and fabrication rooms it must be made a duty to the personnel to wash the hands after each interruption of the work.

5) Care has to be taken by suitable measures that the rooms are, as far as possible, free from rats, mice, crotonbugs, flies and other vermin; if required, they must be disinfected.

6) Dogs are not allowed in the rooms.

2. Implements.

1) The boning tables must consist of a massive removable plate (oak) or of firmly joined wood and must not show any fissures and cracks.

All machines, knifes and implements used for the manufacture of meat or sausage articles

and preserves must be ready for use and perfectly clean. All rooms, machines and implements, tables and floors as well as kettles and troughs must be cleaned thoroughly every day after work. The water for cleaning the implements and machines must live up to the requirements to be fulfilled by drinking water. Moreover, implements and machines must be so that they do not yield substances injurious to health (especially antimony, lead, cadmium, zinc or small pieces, splinters, scales etc.) Implements and machines which are enamelled inside as well as zinc troughs must not be used. Airing and cleaning facilities of the rooms must live up to modern requirements.

3. Personnel.

Prior to being engaged, the whole personnel which comes into contact with the goods to be manufactured must undergo a medical examination especially as regards the undermentioned contagious diseases and the carrying and transmitting of excitants of deseases. If necessary, this examination has to be repeated every 6 months or, when illnesses frequently occur, at shorter intervals. The result of the examinations and the name of the person must be listed at regular intervals. The list has to be chown to the inspection official and, if desired, also to the respective military physician of the physician of the recruiting district or its representative.

If the examinations cannot be carried out due to the shortage of physicians a general medical health inspection of the personnel has to take place. A bacteriological examination of the stool and the urine of carriers of diseases shall take place in any case. If the general medical health inspection raises the suspicion of illness of some person, a thorough examination of the said person is necessary.

The medical examination as to sexual diseases must be carried out only if a person is suspicious of suffering from the said disease.

The costs of the medical examination have to be borne by the firm.

Persons suffering from a contagious disease, especially from typhus, para-typhus, dysentery or open tuberculosis or suspected from suffering of a contagious disease or transmitting permanently or temporarily excitants of diseases, furthermore, persons having ab-

scesses, purulent wounds or eczema or suffering from sexual diseases may not take part in the preparation of victuals for the Wehrmacht nor persons such as attendants to sick persons, disinfectors, rag-pickers or the like or undertakers.

2) All persons who are engaged during the fabrication have to be examined for the first time at the engagement.

3) Persons with injured or bandaged hands may not take part in the working up of meat. They must do some other work.

4) The persons for the manufacture of meat, sausage and preserves must, as far as the war-conditions allow of it, wear a washable jacket (men) or a washable frock (women) and, on that, an apron which can be washed off. The sleeves must go to the elbow. During work, light caps or cloths have to be worn on the head. Women who come into direct touch with the victuals must have a cover on their hair during work so that no hair or the like may get into the victuals. In which manner this can be arrived at, must be decided by the manufacturer. Furthermore, men carrying the meat, must have a head-covering which can be washed off; the meat must not get into touch with the hair. When the working hours are over the personnel shall not stay in the rooms.

5) The men working at the machines shall have an extra protection against small parts of meat sputtering about. They must wear an apron of a fabric which can be washed off, leather or oilcloth and which covers the whole front part of the body. Sleeves of the same fabrik must cover the arms. The prescription for preventing accidents must be observed.

B. III. Sausages.

1) Kinds of sausages.

Sausage consists mainly of boiled or unboiled meat, bacon and organs and is a meat-preparation in artificial casings or those made of prepared intestine; it has to meet with the provisions of the law concerning foodstuffs. Deviations therefrom due to the use of cereals, oil or the like are especially prescribed by the recipes and are only valid for the Wehrmacht. Cereals are worked up according to separate prescriptions, (cf.B III, 3).

Sausage shall be more or less durable and well-tasting foodstuff prepared in the commercial way from the edible parts of beef, pig and calf; it must not have a strongly peculiar, though harmless, taste, it must have an agreeable and well flavored taste and must have the solidity and color characteristic of the particular kind; it must not show any decomposition features - odor of putrefaction (a moldy-rancid odor similar to that of butryc acid) --, Intestines, mesentery (except that of calf) and other parts and waste which are not utilizable in the meat trade must not be worked up into the sausage. Entrails and especially blood may only be used in the fresh state, which means that entrails and blood, when used, must have an unobjectionable appearance, odor and taste.

The composition of the sausage differs according to the various kinds and is fixed by special recipes. The preparation of the several recipes will be fixed separately. The recipes are considered <u>as minimum requirements.</u>

Kinds of sausages:

1) durable sausages (cf. B IV)
2) fresh sausages
   a) raw sausage
   b) Brühwurst (sausage to be treated with boiling water)
   c) Kochwurst (sausage to be boiled in water).

2) Fresh sausage.

1) Raw sausage is, as the name implies, prepared from boiled and comminuted lean and fat with addition of common salt (or nitrite pickling salt) and spices. The addition of cereals and/or non-animal fats can be prescribed. The raw sausage must have a uniform pink color and be smoked so that it has an agreeable, not bitter taste and must be durable for a longer time than Brühwurst and Kochwurst. Natural and artificial casings may be used. Raw sausage, when delivered, must be fresh, dry outside and spreadable as far as possible.

2) Brühwurst must consist wholly or partly of Brät" (finely chopped) of muscle flesh of lean animals, treated with water in the cutter with addition of animal fat, salt and spices. The addition of cereals and/or non-animal fat may be prescribed.

The quantities of water allowable according to the different recipes must in no

case be surpassed. The supplier is responsible for a suitable selection of the "Brät"-meat. It must be guaranteed that with the prescribed addition of water the sausage does not deposit, tightly adheres to the case and, when being cut, separates no water.

For the preparation of "Jagd"- and "Bier"-sausage "Mitteldärme" (mean guts), as far as available, or artificial casings are to be used. "Bier"-sausage may also be filled in calfbladders or ox-"butten".

For filled ham, ox-"butten" or artificial casings up to caliber 12o mm may be used.

Decisive for the inner and outer color of the "Brüh"-sausage is the reddening of the meat. The said sausage has to be smoked in hot smoke until it assumes a golden-yellow coloration.

Jagdwurst, Bierwurst and filled ham have to be smoked with cold smoke after being treated with hot water so that they keep better in the hot season and do not become smeary on the outside.

When delivered, the sausage must be dry outside.

Fresh sausage for frying which is served for luch is considered as Brühwurst; it is, however, neither treated with boiling water not smoked and may only be prepared on the very day it is delivered.

Bockwurst and fresh sausage for frying may only be furnished in chains of small sausages.

3) Kochwurst consists of brawn, previously boiled or unboiled, and fat of pigs, oxen or calves with addition of liver, blood, skin, entrails, salt and spices. Entrails, fat gut, skin and heads may only be used if they have been boiled prior to use whereas muscle and pig fats must not be boiled before being added to the sausage mass. The addition of cereals and/or non-animals fats may be prescribed. Any addition of "Brät" instead of dices of meat is not allowed.

For the preparation of Kochwurst there are to be used in the first line casings made of natural intestines. Only if they are not available artificial casings may be used (paper cases fast to boiling, "Cellophan", "Naturin", "Krensit"). Caliber 45/7o mm. For tongue-sausage there may be used pig bladders, small oxen-bladders or oxen-

"butten" and for pickled meat-sausage oxen-"butten" or for both kinds of sausages artificial cases of same caliber.

The sausage must be boiled uniformly throughout and must be delivered only in the fresh and well dried state. The sausage has to be smoked as it is commercially usual, especially in the hot season. Fat as well as dices of fat and meat must be uniformly distributed throughout the whole sausage.

3. Mass of cereals.

The preparation and application of a cereal mass has to take place as follows:

1) For the preparation of the cereal mass there may be used, according to the substances supplied, soya beans, rye or maize. These are first washed with water and freed from foreign substances, The water has to be renewed until it remains clear. After pouring it off, the material is brought, for swelling, into a vessel free from copper.

100 kilos of beans, rye or maize in about 300 liters of water, are caused to swell for 24 hours at a temperature of 15-18° C.

The swollen mass is introduced into a low-pressure or ordinary vessel free from copper and, while stirring, boiled until soft with that quantity of water which is absolutely necessary for obtaining the cereal masses mentioned under 3) of this paragraph. When calculating the necessary quantity of water, the loss thereof by the formation of vapor during the boiling is to be considered. After boiling, the cereals must be so that they can be crushed smoothly without coarse-grained residues.

Thereupon, the boiled mass is passed in the warm state through the 2 mm disc of the mincing machine and subsequently "gekuttert" with addition of 10 grams of salt per kilo until the mass has assumed a paste-like consistency without any solid material.

The mass is then spread in thin layers in vats or bowls which are placed in cooling chambers. Only such a quantity of the mass may be prepared as will be used within the next three days.

The mass has to be added in the hot state to the Kochwurst and in the cold state to the Roh- and Brühwurst.

2) Cereal flakes are made to swell in such a quantity of pure cold water as is in proportion to that of the mass to be obtained and are stirred repeatedly. After 1 hour the flakes thus treated are passed through the finest holes of the mincing machine and subsequently "minced". The mass of flakes is

directly ready for use and is added to the sausage mass.

3) The quantities of rye, maize, soya beans and soya flakes to be used have to be calculated on the basis of following yields:

a) soya beans of Manchurian origin:
loo kg of soya beans - 25o kg of cereal mass

b) soya beans of south-east-European origin:
loo kg of soya beans = 22o kg of cereal mass.

c) soya flakes:
loo kg of soya flakes = 23o kg of cereal mass

d) Rye and maize:
loo kg of rye or maize = 28o kg of cereal mass.

B. IV. Durable sausage and durable meat.

1) Durable sausage.

For durable sausage there must only be used fresh and dry meat and fats of ripe, entirely fattened pigs and oxen which were allowed to repose well before being slaughtered. Meat which has hung for a long time and frozen meat must not be used for durable sausage. As addition of fat, fat bacon (solid to the touch), or belly-bacon in well cooled state is to be used.

The working rooms must be cool and the air must be pure and, as far as possible, free from germs. Rooms, machines, implements and personnel must be very clean.

The meat has to be shred by means of the chopper and chopping block or rapid cutter or "Heikena" with sharp knifes or discs.. The finished sausage-meat has to be well kneaded before being filled in (if possible with a baling-press) and must be brought into the cylinder of the sausage filler without any air-interspaces.

The sausage has to be dried in such a manner that a good throughout-reddening from inside to outside takes place and that the skin does not dry too soon and becomes impermeable. The skin must not detach from the sausage-meat. The method of preparation is at the discretion of the manufacturer who is responsible for it.

Since durable sausage is particularly sensitive to humidity after being smoked, the sausage must be stored until reception

only in rooms which are suitable for storing durable sausage.

Durable sausage ready for reception must fulfil the following conditions:

1) The skin must not have detached from the sausage-meat;
2) The sausage must be uniformly firm to the touch at all places;
3) when being cut, it must have a uniform fresh color without discoloration at the borders, without hollow spaces and formation of threads; odor and taste must be satisfactory.

In order to prevent a primature drying of the durable sausage ready for reception and to protect it against noxious influences from outside the application of special coating masses can be ordered.

2) Durable meat.

By "durable" meat" meat of pigs and oxen which has been made durable for a prolonged time by pickling and smoking is to be understood. A satisfactory and durable meat can only be obtained if greatest care is taken by experts in selecting the animals to be slaughtered and in carrying through the slaughter. For the preparation of durable meat there may only be used meat of healthy and entirely fattened slaughter animals which has a solid and dry consistency and is not too streaky with fat since the latter gets rancid after a certain time. The slaughter animals which serve for preparing durable meat must well repose before being slaughtered and must not be excited.

There exists:
1) pork durable meat and
2) ox durable meat.

For protection against noxious exterior influences the application of special coatings may be ordered.

Ad 1)
a) Lean bacon.
Lean bacon consists of the belly portions with ribs of well fattened, but not too heavy, chilled pigs. It must be pickled so as to be durable. The pieces must be cut entirely straight, rectangular and without waste. Meat at the borders, belly parts with glands have to be removed, sharp edges, especially at the skin, have to be rounded off. The skin on the rib-bones must not be removed. The meager bacon must have a mild taste, be firm to the touch, when cut, no brine must run off.

show a natural intense meat-color. The lean bacon must be strongly smoked in cold smoke (chestnut-brown). After hanging for a sufficient time, the spring bacon must be coated, if required, to protect it against noxious outer influences, flies and maggots.

Time of preparation: about 2o days.

Guaranteed durability: 6 months after reception.

b) Bone-ham.

This ham has to be prepared from the meat of the leg. The pendental bone has to be separated and the head of the bone has to be freed so that the joint-oil is removed. The thick part of the leg has to be cut out to the joint so that the ham can be hung up at the sinew besides the thick part of meat. Suitable expert wet and dry pickling, respectively. The salt content of the finished goods must not essentially surpass 6-7 % in the mean (fat and brawn).

Smoking in cold smoke until chestnut-brown. After smoking and appropriate time of hanging the ham has to be provided, if required, with a protective coating against noxious outer influences, flies and maggots.

Time of preparation: about 4-6 weeks according to the weight of the ham and the manner of pickling.

Guaranteed durability: 6 months after reception.

c) Back piece.

By back-piece the chop- or cutlet piece with adhering backfat of not too fat pigs is meant. Saw off ribs shortly and saw off the back-bone obliquely. Cut rectangular pieces. Round off sharp edges, especially at the skin. Both, wet and dry pickling are permitted. The salt content of the finished goods must not essentially surpass 6-7 % in the mean (fat and lean). Smoking must be in cold smoke until chestnut-brown. If required, protect with a coating against noxious outer influence, flies and maggots.

Time of preparation: 4-6 weeks according to the weight of the piece and the manner of pickling.

Guaranteed durability: 6 months after reception.

d) neck.

The upper part of the neck, with adhering neck-bacon has to be cut free from bones, rectangularly, free from offal and plainly. Sharp edges, especially at the rind ends have to be rounded off. Wet- or dry-pickling are permitted. The salt content of the finished goods must not essentially exceed 6-7 %

on an average (fat and brawn).
Smoking in cold smoke until chestnut-, colored. For protecting the necks from injurious external influences, from flies and maggots they are to be provided with a coating, if desired.

Time of manufacture: 4 weeks.
Guarantee for stability: 6 months from the day of reception.

Ad 2)
Durable meat of hind and fore quarter of ox.

As durable meat of oxen only meat of full-fleshed oxen is to be used. The hind quarter is cut up into specific parts - as grown - and the single parts are cut according to fleece. The weight of the single piece must not exceed 3 kg. Beef must not be fatty.

Regarding the hind quarter there must not be used: roast beef, fillet, belly-lobes and crural muscle meat.

Fore quarter of oxen shall not be used for manufacturing durable meat. For this purpose the breast (without bones) may at best be used.

The cut parts are naturally and gently salted, then smoked in cold smoke after burning down. After finishing the pieces have to be provided with a coating, if desired, for protecting them from injurious external influences, from flies and maggots.

Time of manufacture: about 3o days.

Guarantee for stability: 6 months from the day of reception.

B. V. Bacon and lard.

1. Fatty bacon (back-bacon)

By the term fatty bacon the fatty parts of back-pieces of pig are to be understood.

For preparing fatty bacon the back-fat of well fed pigs shall be used which is salted after good pre-cooling, subjected to good watering after the salting process, then dried naturally or by machine and finally strongly smoked in cold smoke. The bacon must be cut free from offal, rectangularly (from hip-bone to beginning of neck-bacon).

The middle thickness of back-fat has to amount to at least 4 cm and at the thinnest place to at least 3 cm. The bacon must not be rancid, its fat must be compact and white,

its taste mild and proper; the rinds must not show places suffused with blood.

When pigs with a live weight below 125 kg are used for preparing fatty bacon, an exact standard should not be applied in determining the thickness of back-fat. Accordingly, the back-fat is not so thick as prescribed.

Time of manufacture: about 2o days

Guarantee for stability: 6 months from the date of reception.

2. Lard.

For manufacturing lard by boiling out only back-bacon free from rinds and skin-fat of the belly of hogs must be used. Fleshy parts adhering to back-bacon and skin-fat of the belly have to be removed, the bacon and fat have to be shred by means of meat-chopper or with the hand and boiled out without addition of spices, salt or onions.

Back-bacon and skin-fat of the belly must be worked up in as fresh a state as possible and must not show tendency to decomposition or infection with molds (owing to wrong storage and treatment); fat in this state has to be excluded from being worked up to lard.

Lard must not contain residue of water or crackings, must show proper non-tallowy taste and white appearance. The water content must not exceed o.5% as determined by chemical investigations.

B. VI. Frozen sausages and meat.

1. Frozen sausages.

(1) The manufacture of frozen sausages corresponds with the recommandations of preparing fresh sausages. The composition of the sausages must not be too poor in fat in order to avoid separation of the sausage goods in thawing.

(2) For the manufacture of frozen sausages special prescriptions are valid. With regard to the freezing process the casing calibre of the sausages must be 55-7o mm. The exclusive application of artificial cases, with the exception of sausages for frying, is prescribed in order to prevent the sausages from becoming smeary at further storing after melting.

(3) The filled and air-dried sausages have to be pre-cooled in the cold storage room at + 0° to +2° C before freezing and then to be frozen within lo hours at the latest in the freezing plant in such a manner that the core of the sausages has reached a temperature of -15° C.

(4) Before bringing the sausages into the freezing room they have to be put into an especially prescribed package and be frozen in this manner.

(5) The freezing process is terminated when the core of the sausages has reached the temperature of -15° C.

(6) Storing is conducted in freezing rooms at -15° C.

(7) The frozen sausages are dispatched in cooling-cars or cooling-vessels. The transport temperature must not exceed -8° C.

(8) The frozen sausages show, in observing the freezing chain which must be proved, a stability and capability of being stored amounting to 1 year and after leaving the cooling chain those of normal fresh sausage.

2. Frozen meat.

(1) Kinds of frozen meat:

There are to be distinguished:

a) frozen meat in the form of quarters of oxen,
b) frozen meat in the form of ahlves of pigs,
c) frozen meat in the form of whole bodies of calves,
d) frozen meat in the form of whole bodies af wethers,
e) frozen meat in the form of bricks or bales of oxen, pigs, calves or wethers and in block form of oxen and calves.

(2) Demand on slaughter cattle.

For the manufacture of frozen meat the indications of section A of these conditions are sound with regard to the demands on slaughter-cattle The meat to be freezing must be taken from animals rested before slaughtering.

(3) Pre-cooling.

The meat destined for the manufacture of frozen meat has to be pre-cooled at ± 0° to 2° C for three days.

(4) Prohibition of working up single parts.

For the preparation of bricks, bales or blocks of frozen meat the following parts must not be used:

a) of ox: head, bloody throat cut, udder of cows and heifers, tallow, hind-legs from ankle-joint downwards;

b) of pig: head with fat cheek, bloody throat cut, back-fat, skin-fat of the belly, middle spongy belly part (paunch), feet.

c) of ox and pig: tongue, entrails (heart, lungs, liver, stomach, spleen, kidneys including kidney-suet, mesentery, etc), spinal marrow, blood, bones, tendons, cartilages, lymphatic glands, pancreas and other parts not adapted for freezing.

(5) Frozen meat in the form of whole bodies, halves and quarters.

a) After normal pre-cooling the whole bodies or,halves and quarters have to be frozen hanging in freezing plants without coming into contact with each other. Freezing has to be conducted as quickly as possible. The freezing process is terminated when the core of the meat shows a temperature of -7° C within 4-6 days at the latest. This temperature has to be determined by means of stick termometers at various control pieces per freezing lot and proved by books.

b) After termination of the freezing process the whole bodies, halves or quarters are to be stored in freezing storage rooms in staples of an altitude up to 2.5o m at a temperature of -15° C. The frozen meat must not be packed directly on the floor; below the lowest staple layer a wooden grate is to be put with a distance of laths of 1o cm. The frozen meat has to be stacked in such a manner that between staples and walls of the freezing room is a distance of 2o cm. The single staple layers must not contain any intermediate layers of wrapping paper, corrugated paper and the like. Narrow control ways have to remain among the single staples.

(6) Bricks of frozen meat.

a) For the manufacture of frozen meat bricks the meat of the animals has to be cut off and shred so much as is necessary for preparing the prescribed package. Superfluous planes formed by the cuts must not be formed leading to avoidable loss in weight owing to giving off juice in melting. Working up of meat with formation of frozen bricks has to be carried out in cooling rooms adapted for manufacturing durable sausages.

b) For wrapping the meat according to indication of the orderer water-tight parchment paper or cellglass fast to weather is sed in the sizes

96 x 74 cm for the 9½ kg - package
60 x 65 cm for the 4½ kg - " and
43 x 55 cm for the 2¼ kg - "

The wrapped meat is packed in boxes without cover in the sizes (inside measure)

39.5 x 35 x 6.8 cm for the 9½ kg - package
20 x 35 x 6.8 cm " " 4½ kg - " and
18 x 20 x 6.8 cm " " 2¼ kg - "

Two bricks of 9½ kg, three bricks of 4½ kg and two bricks of 2¼ kg are put in a case of corrugated paper with inside measure 41 x 28.6 cm,

Lowest layer	1	meat	brick	of 9½ kg
second "	2	"	"	each of 4½ kg
third "	1	"	"	of 4½ kg and
	2	"	"	each of 2¼ kg
highest "	1	"	"	of 9½ kg.

The case of corrugated paper is closed with 2 steel bands (titanium steel band) of a width of 0.3 x 16 mm. The steel bands must not be drawn too tightly in order to avoid damaging of the case. In order to use again the bands, the low band has to surpass the looking place by about 10 cm. Into each large scale package a slip has to be put with the following contents:

Stability of the intact large scale package in summer not longer than 4-5 days after taking out of the freezing room.

1. Store the large scale package in the freezing room until delivery to the parcel-office.
2. Protect from sunlight and wetness by covering after taking out of the freezing room.
3. Stack up tightly.
4. Only thaw and open shortly before use.
5. Thaw contents in the air after taking out, then treat like fresh meat.
6. When time for thawing is lacking, meat may be given to field-kitchen in frozen state.
7. Consume wet packages as quick as possible

A similar slip has to be labeled on the top of the case of corrugated paper with glue resisting to cold or fast to water. Each small package has to contain at the side and each large package at both head-sides a label with the following data:

Firm of manufacture
contents (frozen beef or pork)
net weight
month and year of preparation
end of responsibility.

c) The cases are lined with parchment paper or cellulose. The paper must be carefully pushed into the low edges and corners and must not tear; at the sides it must be drawn up.

The prepared meat-pieces are packed into this paper in such a manner that the case is uniformly filled without the walls being swelled out. Altitude of meat package is 7 cm from floor. The paper or the foil is put together above the meat in such a manner that flowing out of the meat-juice is not possible when thawing.

In order to avoid dulging of cases during filling, simple wooden frames should be used during the filling operation.

The meat may also be frozen in tinned iron chests which correspond with the inside measure of the cases (altitude of 7 cm).

For the plate-refrigerator tinned iron frames or iron chests must be used.

d) In the rapid freezing apparatus the meat is frozen at a temperature amounting to at least -30° C. After termination of the freezing process the core and the fat places must show a temperature of at least -12° C. At beginning of the production the necessary time for freezing must be determined and fixed on paper. It must not be shortened during the further preparation of frozen meat.

Before beginning the production with a new type of apparatus the following test must be made: With fully loaded equipment under usual working conditions 5 bricks have to be sawn through at two places or cut through with the hatchet after the expected freezing time and the soft intermediate layer has to be measured in millimeters. If an intermediate layer cannot be ascertained, the test must be repeated after a freezing time shortened by 10 minutes. In case a soft intermediate layer is present, the test should be checked according to thickness of the layer after a freezing time prolonged for 10-20 minutes. The test results have to be communicated to the High Command of the army. To test the equipment the control cited above has to be repeated every fortnight. The tests must be conducted in the presence of the control-officer (-employee). The result is fixed on paper.

The meat bricks used for testing have to be melted and consumed as soon as possible since they cannot be stored.

The rapid freezing apparatus and its working method must be carefully supervised. With regard to time of freezing and temperature of heat transmitting agent (salt lye) exact notes must be fixed on paper.

For rapid freezing only the apparatus must be used which has been approved or arranged by High Command of the army.

e) After taking the frozen bricks out of the freezing case inspection must be made to see that the paper is not damaged. If the paper is torn, the meat brick must be wrapped in another sheet. The net weight of every brick is ascertained and noted on the label of the carton.

Then the large package is put together, tied up and provided with the necessary statements.

In no event must small packages stand for a longer time before they are placed in the larger packages.

f) The ready packages may be stored at the manufacturing place, up to the time of transport to the refrigeration storehouse, in an intermediate store of -15° C. If there is no intermediate store, the ready packages must be brought daily, in summer at least twice a day, to the refrigeration storehouse. Up to transport they must be stored cool and dry at the manufacturing place, on storing laths without contact with the walls and stored as tight as possible without interspace.

g) All the package materials may be ordered from the firm Solo-Feinfrost GmbH in Berlin-Grunewald, 46/47 Hohenzollerndamm. This firm will procure them - in order to make quality and prices uniform - and will cause them to be furnished immediately to the consumers.

The bill will be sent by the firm Solo-Feinfrost or by the furnisher. The amount is paid immediately to the furnisher.

(7) Frozen meat in form of bales or blocks.

Removal of bones is to be carried out as explained above (cf. bricks of frozen meat). The boneless meat is rolled to bales and kept together by seams. Or it is firmly packed, quarterwise, in chests, and frozen. Suitably the chests are laid out on paper impervious to water. After freezing the frozen blocks are taken out of the chests and stored like frozen meat.

3. Guarantee for durability and responsibility.

For the manufacture of the rapidly frozen meat and fresh sausage according to these conditions as well as for their good state and durability, the firm gives a guarantee of one year provided that the material is

appropriately kept and stored by the competent army office in refrigeration houses or rooms with a temperature of at least -15° C.

The army office must prove, in the case of objections, that the storage has been appropriate. For this purpose there must be daily ascertained the room temperatures in the single refrigeration store rooms and registered in a special book (a special column for every room). The records must be certified by the army office and by the administrator of the firm having let the rooms.

The responsibility begins with the first day of the month following the manufacturing month.

A book is kept on the stored quantity of frozen meat and sausage by the respective army provision office according to Wehrmacht Verwaltungsordnung IV, Nr. 367-375.

If frozen or fresh sausage is spoiled during the period of responsibility by defects to be defended by the firm, or if the meat does not correspond with the conditions, the firm will make amends free of charge or pay back to the Reich pay office the amount therefore received.

B. <u>VII Dried meat.</u>

1. For preparing dried meat only f r e s h meat which is satisfactory from a hygienical point of view, is to be used. Meat which is made durable is not admitted to be worked - without prejudice to paragraph 4 -. Selection of the slaughter-animals is made according to the product to be prepared and to the method of preparing.

2. Heads, bloody neck cuts, tails, fat, sinews, bones and all kind of entrails must not be used for preparing dried meat.

3. Dried meat is prepared by the methods acknowledged by the OKH (Chief Command of the Army) according to the conditions of every single case.

The dried meat is to be prepared in such a way that its water content amounts to about 5 - 9 % (depending on the meat's quality) and its salt percentage to 5 to 8. Seasoning is allowed according to special impositions. In concordance with § 1 part 1 of the regulations on inadmissible additions to and treatment of meat of October 31, 194o (RGBl.I, page 147o) application of the following substances or preparations containing them is prohibited:

a) Hydroxides and carbonates of alkalis, alkaline earth and ammonium.
b) Aluminium compounds.
c) Boric acid and its compounds.
d) Chloric acid and its compounds.
e) Dyestuffs of every kind.
f) Hydrofluoric acids and their compounds.
g) Formaldehyde and substances yielding formaldehyde, when used.
h) Organic acids and their compounds save acetic acid, lactic acid, citric acid and their sodium compounds.
i) Phosphoric acid and their compounds.
k) Smoking agents. except fresh smoke.
l) Sulfurous acid and its compounds.

To the organic acids and their salts especially belongs benzoic acid and its salts.

4. Salting, pickling and (or) smoking as well as seasoning immediately before drying is admitted depending on the given order.

5. Dried meat must be supplied in light-, air- and waterproof packages in compressed pieces of 250 g to 600 g. Any deviation of the package form may be settled when the order is given.

6. Dried meat is to be stored in a cool and dry state without admission of light. It must not be packed nor stored together with smelling substances. Also mouldy rooms must be avoided. Dry meat is to be protected against noxious organisms. On conveyance dried meat must be protected against moisture by packing it into cases.

7. For dried meat which is stored and treated orderly, a warranty of 6 months, reckoned from the beginning of the month after preparing, must be given.

8. The packages and cases must be provided with a designation according to part C II, 5 of these regulations.

B. VIII. Preserves.

1. Meat, sausage, lard and milk preserves.

(1) For the preparation of preserves special recipes are stated in these regulations only destined for preparing preserves for alimentary logistics. There are distinguished

a) Meat, sausage and lard preserves,
b) Mixed preserves.

(2) The raw material to be used for preparing meat, sausage and lard preserves must correspond to the conditions as to cattle

and meat settled in these regulations.

It is stated in the different recipes how the various classes of slaughtering valne are to be distributed with regard to their processing. On principle the animals of higher quality must be used for pure meat preserves and those of lower quality for sausage preserves.

(3) Mixed preserves means durable goods consisting of meat, potatoes, vegetables as well as broth and spices, preserved hy heating (sterilizing) them within hermetically closed vessels. They must be conditioned in such a manner that they represent a ready meal. Mixed preserves of legumes, peeled grain, millet and especially noodles and rice must be neither too thick not too thin. Especially leaf and root vegetables must not be too thin. The mixed preserves must be of an agreeable smell and taste. The spices, however, - especially "Maggi"-spice - must not predominate. Salting too much is to be avoided in any case.

(4) For mixed preserves only meat of the slaughtering value classes AA-B (meat quality I) must be used. It must meet the requirements settled herefore with regard to cattle and meat.

(5) In mixed preserves the meat portion must consist to at least 3/4 of lean in not more than two single pieces unless the individual recipes prescribe smaller dices. Working off belly parts (paunchs) and tallow is not allowed.

(6) When working pork for mixed preserves it is to be observed that the flesh must not be too fat.

(7) As to the condition of the other raw goods used for mixed preserves the following rules are to be observed:

A) P o t a t o e s .

They must meet the requirements of edible potatoes fixed by the regulations of the potato trade of the Reichsnährstand in the version of January 10th, 1939. They must be sound and duely ripened. They must not be mouldy, pockmarked nor spotty, nor be damaged by germinating or frost. Before the purchase, it must be tested whether they assume a soft and mealy consistancy.

b) L e g u m e s .

The legumes should be taken from the last crops. They must be fully ripened, of a size and color as homogeneous as possible, easily and uniformly cooked. The legumes must not be mouldy, fragile, wrinkled, nor remarkably worm-eaten, nor must they be mixed with foreign substances. The pods ought not to be thick. The maximum of the permitted percentage of worm-eaten fruits is 8%; that of beetles: 1 beetle per kilogram.

The quality of legumes must be ascertained by a cooking test. Peas and beans must be cooked uniformly soft in at most 2 1/2 hours, lentils in 2 hours.

The following sorts usual in trade may be taken: Large peas or Viktoria peas, diameter generally more than 7 mm, middle peas, diameter generally 6-7 mm, small peas, diameter generally below 6 mm. Viktoria peas are suited best.

White beans: White flat, long, short or round beans.

Lentils: Large lentils ("plate or farthing lentils") with a diameter of more than 6mm, middle lentils with a diameter of 4.5 - 6 mm, small or sugar lentils diameter below 4.5 mm. Lentils from India must not be worked up, as there are always beetles.

c) M i l l e r y P r o d u c t s .

Rice: Rice must have a light glassy appearance and a sound smell. There must be full, sound grains. Rice should be hard, dry and storable. It must not be contaminated by dust, chaffs, shells flour and foreign substances, and not be broken, worm-eaten or moldy. When cooked it must not yield much slime, the taste must not be salty or sourish. The grains of good sorts swell when cooked but are not dissolved. They retain their grainy state and do not stick together. The stronger and the more uniformly transparent the grains are, the more valuable they are. A silky lustre simultaneously present in all kernels is considered as a sign of special value.

The following sorts of rice may be taken: Karolina-rice: one of the best sorts - consists of white, transparent, hard and pure grains. Java-rice: white transparent long and grooved grains, lustrous or floury at single parts. Patna-rice: The grains of the best sort are very long and somewhat angular, because of their small breadth and thickness. They are

almost completely glassy, in some cases there is a floury transparence.
Rangoon-, Siam-, Bassein-rice: mostly small and thin grains.
Of these sorts Rangoon is traded most.
Italien-rice: from the Po-plane, consists of short, thick and round grains.
Valencia-rice.
Broken rice must not be used.
Groats. Only groats of grain number C 3 - 5, sound and without objection, may be used.
Millet. Sound, peeled edible millet.

d) C e r e a l s .

There should be used strip noodles formed from hard grits. As far as available there may be used macaroni or spaghetti.

e) V e g e t a b l e s .

Fresh vegetable peas: Only fresh pluckled peas shall be worked up. Unsound, yellow peas, parts of shells, tendrils etc. must be removed.

Green beans: They must be used in the fresh state and must not be faded and moldy. Spots dark or otherwise colored, or rotten spots must be cut out. Beans in an advanced state of maturity with strong formation of bast and fibers should not be taken. Only beans of fiber-free sorts must be used.

White cabbage, savoy. The cabbage must be of the latest crop, it must be sound, of good taste, natural aroma and fresh color. It must be free of sand, insects and their larvae and secretions, and of webs of worms. It must not be damaged by frost and not be taken from fields irrigated with sewage. Trunks and stems must be completely removed. Cabbage is cut into pieces not too small. Before putting in cans the cabbage is scalded (blanched). The scalding is restricted to the smallest possible degree.

Chemical preservation agents, bleaching agents or other chemicals must not be used. Artificial coloring with coal tar dyestuffs as well as coloring green by means of copper salts are forbidden.

Carrots: There should be used only so-called Nanteiser carrots or red edible carrots.

They must be cleaned, free of worm-eaten spots and not damaged by frost.

Rutabaga: There must only be taken sound, cleaned, yellowish turnips. They must not be woody and damaged by frost.

Tomato pulp: It must be free of additions, of natural color and of a good aroma.

2. Filling and weight tests.

The filling is carried out with the weight fixed in the recipes. Every can must be weighed before being closed. The border of the can must not be contaminated before shutting in order to avoid possibilities that the cans become not tight.

3. Designation.

1) All preserved materials to be manufactured for the Wehrmacht must be designated by punching the lid. The lid stamping must contain the following statements:

a) Contents of the cans,
b) number of the manufacturing firm,
c) month of manufacture,
d) year " " ,
e) net weight (not necessary with mixed preserved goods).

Example: R
10 3 44
850 g

The punches must not have sharp borders in order to avoid the damaging of the cans. The lid stamping must be easy to read. If it is technically possible (if the stamp colors are resistant to fat), the designation may be made by rubber stamps. If there is no possibility to punch the net weight, the net filling must be made according to the prescription given for the used kind of cans.

The prescribed stamping (marking) of the lid is to be used only for preserves which are produced as Wehrmacht's supply. In order to avoid any mistake, preserves intended for civil use or for prisoners of war etc. must not be marked as stated before. Those preserves which are produced by order of the Supreme Command of the Kriegsmarine bear the additional marking: KM.

Furthermore, the Reichsstelle for beasts and animal products causes the production in special producing plants of preserves made for own purposes from "Freibank"-meat (ration exempt). These preserves which are not intended for the use by the Wehrmacht, bear the additional marking: "Freibank".

2) The marking of the outer packing must correspond with the packing prescriptions according to part C II of these conditions.

3) The various abbreviations of the marking of contents are determined in the receipts

of parts E and F as follows:

Lid stamping	Contens	Receipt
B schi A	beer ham (for hot zones)	E 1
Bw	beer sausage	E 2
Bw S	beer sausage with cerealia	E 3
Bl w	black pudding (receipt I)	E 4
Bl w	" " (" II)	E 5
Blw S	black pudding with cerealia	E 6
Gr.Bo H	green beans with potatoes and mutton	F 1
Gr.Bo R	green beans with potatoes and beef	F 1
Gr.Bo S	" " " " " pork	F 1
Bo R	white beans with potatoes and beef	F 2
Bo 5	" " " " " pork	F 2
C	corned beef	E 7
E B	roast duck	E 9
fr.Erb S	Fresh peas with potatoes and fresh pork	F 3
Erb S	yellow peas with potatoes and smoked pork	F 4
Erb S	green peas with potatoes and smoked pork	F 5
Fl rA	red meat sausage (for hot zones)	E 8
G B	roast goose	E 9
Gr p R	peeled barley with beef	F 6
H R	mutton ragout	E 1o
Hi R	millet with beef	F 7
H F	chicken - fricassee	E 11
Hu Gr	chicken with peeled barley and tomato	F 8
Hu W	chicken with white cabbage, groats and tomato	F 9
Jw	"Jagd" sausage	E 12
Jw S	"Jagd" sausage with cerealia	E 13
Kb R	veal and beef	E 14
Kb S	veal and pork	E 15
KF	veal-fricassee	E 16
Kb Rs	veal with rice and wine sauce	F 1o
K R Gu	potato-dumplings with goulash of beef	F 11
Ka Pü	"Kasseler" (smoked meat) with pease-pudding	F 12
Ko S	turnip-rooted cabbage with fresh pork	F 13
Lw	white liver-sausage (receipt I)	E 17
Lw	" " " (" II)	E 18
Lw S	white liver-sausage with cerealia	E 19
Lw A	white liver-sausage (for hot zones)	E 2o
Li S	Lentils with potatoes and pork	F 14
Mo S	carrots with potatoes and smoked pork	F 15
Nu R Gu	"Nudeln" (strips of dough) with goulash of beef	F 16
Rs R	rice with beef	F 17
R Gu	goulash of beef	E 21
R P	pickled beef	E 22
R	beef	E 23
R Nu	beef with "Nudeln" (strips of dough) and tomato	F 18
R S	beef and pork	E 24

R Gu Hö	goulash of beef with small "horns" and "Nudeln" (small horns and strips of dough)	F 19
RLw	beef liver sausage	E 25
Schi	boiled ham	E 26
Schi Benz	boiled ham (for hot zones)	E 27
Schm	lard	E 28
Schm A	lard (for hot zones)	E 29
Schm Fl	pork with lard	E 3o
S	pork	E 31
SA	pork (for hot zones)	E 32
Sp	pickled pork	E 33
SK S	pork jellied head	E 34
WKc R	white cabbage with potatoes and beef	F 2o
wR	venison ragout	E 35
WiKo R	savoy with potatoes and beef	F 21
Wü	small sausages	E 36
Wü Benz	" " (for hot zones)	E 37

4. Sterilizing of the preserves.

(1) The preserves intended for the use of Wehrmacht must be sterilized by means of autoclaves.

(2) Before beginning the production of preserves and then after each 6th month the autoclave devices are to be tested by that department competent to examine such machines. In each case the results are to be submitted to the control officer.

(3) The autoclaves must be furnished with measuring devices, such as writing manometer and writing thermometer in such a way that pressure and temperature are indicated independently. Whichever system of preserving is used, may be decided by the producers themselves. The measuring devices must be attached close by the autoclaves. In order to separately control the temperature the cover must be furnished with a screwable thermometer.

(4) To have a better and more uniform rinsing round the boxes in the cage of the autoclave, it is recommended to place in the center of the cape of the autoclave a hollow round iron fence (Gestänge) reaching to the height of the edge of the cage.

(5) The closed cans are heaped in a chequered form into the cage of the autoclave one upon another and then appropriately sterilized by means of a steam or water bath. The sterilization is made at a temperature of at least 121° C, the following clue indicating the lowest time necessary for sterilization:

2oo g cans		55	minutes
4oo g "		65	"
85o g "		1oo	"
85o g "	with mixed preserves	6o	"
4oo g "	with mixed preserves	45	"

When using larger cans the time of sterilization is to be prolonged correspondingly.

Furthermore there is to be regarded the time necessary for letting off the air at the beginning and the steam at the end of the sterilization, which varies according to the size of the autoclave and must not be too short since otherwise the cans may be damaged. After the cage is introduced, the water must rinse the bottoms of the cans of the highest series.

(6) It is emphasized that the time of sterilization and boiling as indicated in these prescriptions are to be regarded only as a clue and that the firms are not relieved from the guarantee as to the quality and stability of the products.

(7) The water used in the autoclaves must be renewed after each boiling, if it has become dirty. The cans are to be examined after the boiling whether they show a marbled appearance which may be caused by iron containing water or by other ingredients. A small addition of waterglass to the water keeps the tin plate cans in a blank state.

(8) After being sterilized, the preserves are to be stored, each boiling set being separated from the other. They are to be marked by stating the quantity, day of production and number and are to be provided with processing labels. Before the cans have completely cooled down, they are to be cleaned, the use of sawdust or chemical purifying agents, however, is not allowed. Then the cans are to be oiled with non-acid machine oil or paraffin oil. The dirt below the edge of the cover or of the can is completely to be removed in order to avoid formation of rust.

5. Examination of stability.

The stability of the preserves is to be proved by subjecting them to incubation. The incubating test must comprise at least 3 cans per thousand of the produced preserves.

The incubating test is performed as follows: samples taken from each boiling set after cooling are correspondingly marked and put

into the incubator. There they are subjected without interruption to a warmth as equal as possible

a) when intended for use in North and Middle Europe, at 37° C for 7 days if possible (at 37°C for at least 3 days)

b) when intended for use in South Europe and tropical and subtropical zones, at 50° C for 7 days.

If the cans show bombages after that operation, a second incubating test to at least the same extent is to be performed from the same boiling set. If after the second incubating only one can shows a bombage, the whole boiling set must be rejected.

The incubated preserves are to be observed in special rooms for, if possible, further 14 days. The temperature in these rooms is to be kept at 18-20° C but not below 12°C, since otherwise bacteria which are not killed would not or only too slowly develop.

6. Separating of preserves which are not capable of being received.

(1) After the boiling and cooling, samples are to be taken out and their weight is to be checked. The following cans are to be excluded from reception and are to be stored separately: cans with shortness in weight, cans which are to be recognized as being not tight, cans which are unsufficiently cleaned or are beginning to rust, cans showing bombages, bumps or noses, cans with defects of closure and material and cans which have been objected to for any reasons. If there are cans which show noises when being shaken, with the exception of mixed preserves which in most cases show such noises, they are to be stored in cooling rooms for some days and then to be examined once more.

(2) The contents of those cans which have been separated must not be preserved in a new operation for the use of the Wehrmacht.

7. Guarantee of stability and liability.

(1) The firm guarantees the composition of the preserves according to these conditions, the good quality and stability according to the prescriptions stated in parts D - F, the appropriate storage and careful treatment of the products by the Wehrmacht being pre-supposed.

The liability as to the preserves begins in the month following the day of production and finishes at the time determined in these conditions.

(2) The firm replaces by way of the appropriate department (Reichsstelle) those preserves which spoil within the stated time by defects caused by the firm itself or preserves which do not correspond with the agreement. In doubtful cases an expert of the Wehrmacht (veterinary officer) has conclusively to decide whether the contents of a can are spoiled or must be regarded as being spoiled, for instance, when the preserves show a noise when being shaken. When the experts in the examination of spoiled or suspicious preserves discovers the existence of still living germs or the bacterial or chemical decomposition of the contents and when this discovery is confirmed by the Wehrmacht in the examination of further preserves, the whole set of preserves produced in this working step is to be regarded as not being in accordance with the agreement In this case the loss is to be paid by the firm.

(3) The Wehrmacht can decide, whether it will require a compensation from the reserve-stock of the factory or from new production according to the conditions prescribed. By the term reserve-stock only such preserves are included which have been produced under the control of the Wehrmacht.

The Wehrmacht, however, reserves itself the right to require the compensation of meat, sausage and preserves and of any damage in the form of money.

(4) In the case of supplementary supply all expenses are to be paid by the firms.

(5) If the firm does not supply within the fixed time, the Wehrmacht is entitled without fixing any further time to decline the products and to require compensation because of non-fulfilment or to cansel the agreement.

(6) In case of supplementary supply the conditions of quality and liability as stated in the preceding paragraphs are to be applied.

B. IX. Supervision by the Wehrmacht.

1. Supervision of performing the order.

(1) The Wehrmacht is entitled to constantly or occasionally supervise at its own expenses the performing according to the prescriptions of each order, to control the plant and to inspect by appropriate Wehrmacht-departments the rooms needed for producing, packing and storing.

(2) The representative of the Wehrmacht is entitled and obliged to communicate deviations from the receipts to the manager of the plant and to require the production, storage etc. according to the prescriptions.

(3) The supervision or examination of the meat, sausage or other preserves by the representative of the Wehrmacht does not liberate the firm from its own responsibility to produce the preserves in a satisfactory state and from the guarantee of stability of the products.

2. Preparation of an office room and of personnel.

The firm is obliged to place at the disposal of the representative of the Wehrmacht an office room and, if necessary, a typist in order to settle the necessary correspondence.

3. Samples for examination and trying.

(1) In order to make possible the supervision and examination the firm is obliged to place at the disposal of the Wehrmacht samples of the products for examination. These are to be delivered free of cost and postage at the place of production or at any other place to be determined by the Wehrmacht.

The quantity of the samples to be taken or to be required has been determined by a special order of OKH (Supreme command of the army).

(2) As to the preserves, there are to be performed incubating tests in the producer's plant according to the prescriptions of paragraph B. VIII. 5 of these conditions. In case of a satisfactory result of examination the incubated sample is to be added again to the original store.

4. Papers relating to the examination and placard of the receipts.

(1) When producing preserves, the boiling labels, control strips of the measuring devices and all scripts relating to the production of the preserves without being requested are to be submitted to the representative of the Wehrmacht and to be kept until the expiration of liability.

(2) At the time of production the receipts are to be made known to the personnel by placard at an appropriate place.

B. X. Process of delivery.

1. Time of delivery.

The times of delivery are strictly to be kept as agreed upon with the Wehrmacht.

2. Reception.

(1) The provisions of Wehrmacht must correspond to the requirements of these conditions. Only those provisions which correspond to these conditions are to be regarded as capable of being received as garrison or supply provisioning.

In exceptional cases when the provisions produced for the Wehrmacht do not correspond to the conditions as to their quality or capability of being used as supply provisioning, these provisions are to be offered to the Supreme Command of the Army by the producer with new conditions to be agreed upon.

(2) The goods can be received provisionally or finally at the place of production or in a store house determined by the competent Department (Reichsstelle). When the reception is provisional it is left to the receiver to decide about the final reception. The producer is to be instructed in all cases which kind of reception has taken place.

(3) Divergences as to the quality of the goods arising with the reception are decided by the competent Wehrmacht Veterinary Department after the hearing of an expert of the delivering Reichsstelle.

(4) The reception of durable meat, durable sausage, bacon and lard from stores of factories or Reichsstellen in all cases is to be regarded as a final one with regard to the quality and quantity of the goods.

(5) The reception of preserves is to be regarded on principle as a provisional one and is limited to the examination of the quality, packing and outside marking of the boxes and packings according to the prescriptions. The producer alone is responsible for the loading and the numerical completeness of the goods. When forwarding the goods by railway the cars are loaded also by the Wehrmacht.

3. Claims of indemnification.

(1) When the receiver on reception of the goods in packings closed according to the prescriptions discovers lacking quantities and a deprivation during the carriage seems to be excluded,

the producer is obliged to subsequent delivery free of charges. The receiver has the right to require the subsequent delivery of the lacking quantities within 3 months from the day of reception.

The time of 3 months is an excluding time, i.e. after expiring of this time lacking quantities can no longer be claimed. When original loads (whole cars) have been forwarded in the homely war district to another provisioning department of the Wehrmacht, that department which unloads the car is entitled to claim indemnification. In this case the first receiver who has forwarded the car is to be stated.

(2) The producer is obliged to subsequent delivery free of charges when damages or losses of cans have occured which obviously have been caused by defective packing and by disregarding the prescriptions of packing (part C of these conditions).

(3) When bombages are discovered within the times of guarantee according to these conditions, the producer has to replace the cans free of charges. Cans with bombages discovered in the home war district are to be placed at the disposal of that Reichsstelle which replaces the cans. Cans with bombages which are discovered by the fighting army are to be destroyed after a veterinary examination, a statement of the bombage and a protocol with an exact description of the can stamping and, if possible, of the writing on the case should be made. The veterinary examination can be abandoned only if a veterinary officer is not available.

(4) All claims of indemnification are to be directed, if possible, to the competent Reichsstelle with statement of the corresponding number of account, by way of the paying Wehrmacht provisioning department, even in cases where the goods were delivered within the homely war district by supplying another Wehrmacht provisioning department. The statement of the number of account can be abandoned when, the belonging of the goods to a general delivery with a certain number of account cannot exactly be ascertained, The offices of the fighting army take the way which seems to be the best, if possible, by applying to the Wehr kreis-administration which is competent for the producer.

(5) In the case of deprivation of the delivery during the forwarding by railway - with satisfactory packing by the forwarder - the damages ascertained are to be defended by claiming recourse from the Reich-railway.

4. Risk of forwarding.

The forewarding from the place of loading or shipment goes at the risk of the receiver.

5. Payment and assignment.

The payment of meat, meats, sausages has to take place immediately after their reception. When the order has been executed by way of a Reichsstelle, the payment is to be directed to that Reichsstelle. The remittance of money goes at the cost and risk of that public pay-office which makes the payment.

In certain exceptional cases the Supreme Command of the Army can give orders directly to the firms. In these cases the following conditions of payment and assignment are to be applied, so far as the reception of the ready goods is not possible within appropriate and usual time. For preserves which have been produced by the firm but not yet received by the Wehrmacht, the Wehrmacht is prepared to make payments in advance to the firm up to 80 % of the value of the preserves, after the preserves have satisfactorily survived a storing of at least four weeks. For this purpose the preserves are to be assigned to the Wehrmacht. The assigned preserves are to be marked as the property of the Wehrmacht and separately to be stored. They must not be stored in one room together with goods not yet assigned to the Wehrmacht or with preserves which are owned by the firm.

Both the firm and the representative of the Wehrmacht have to keep account of the assigned goods. The conformity of the entries with the assigned goods is to be certified by legally binding signature of the firm and the representative of the Wehrmacht. By the assignment the liability of the firm is not stopped to insure the preserves against theft and damages caused by fire and water for the time of storing.

Appendix XII

New Bread Formula Suited to Low Grade Flour.

Whole Flour Pastry. By A. Welchés. (Institute of Baking).

The whole flour action has produced whole flour pastry which has kept its position and has increased in a short time in recipes

At first a sort of small roll was known, made of a mixture of whole rye and whole wheat flour and partly containing leaven. They consisted of 50 % whole rye coarse ground flour, 70 % whole wheat coarse ground flour and 30 % leaven.

The manufacturing process is as follows:

For 5 kg dough mix.

At 5 o' clock a fore-dough is made of 0.9 kg whole wheat flour, 0.9 l. of water and 1.5 % yeast (calculated on flour). The fore dough must have a temperature of 25° - 27° C. At the same time (5 o' clock) 0.530 kg leaven (Anstellgut), 0.60 kg whole rye coarse ground flour and 0.67 liter water are mixed into leaven, which must have a temperature of 27° - 30° C. at 8 o' clock these fore-doughs will be ripe. 1.2 kg whole wheat coarse ground flour and 0.2 liter water are added. The dough must have a temperature of 30° - 32° C.

The salt percent is 1.5 %, calculated on flour. The dough must rest for 40 minutes after which time it is formed to rolls. After 40 minutes these rolls can be baked, the temperature must be 270° C. Baking time is 20 minutes.

It is recommended to form the surface of this item into a smooth even shape. The same dough is used for fruit-bread (Früchtebrot). The fruits are added at the end of the fermentation process to the dough under addition of water. This dough can be baked in the form of small pieces or in a box-form. In the latter case it is recommended to make the dough softer. The fruits added are: figs, plums, hazel nuts, raisings, almonds, pears, bananas, candied lemon peels, palm-berries, which can be added to 40 % calculated on flour.

In contrast to the upper described rolls, another kind of rolls is made of a whole wheat coarse ground flour dough with yeast. This dough must first be prepared as fore-dough and must have a longer time of rest.

Its composition is as follows:

Rolls.

5 kg. whole wheat coarse ground flour.
3 liter of water approximately
50 gr. salt
50 gr. yeast .
1.5 kg flour is worked into a fore-dough with 0,25 liter water and 50 gr. yeast. After ripening, the remaining amount of flour, water and 50 gr. salt is worked into this dough. After a resting time of one hour, rolls are formed, which are baked 20 minutes at a temperature of 240° C.

Horn shaped rolls and other pastry.

5 kg. whole wheat coarse ground flour.
100 gr. yeast
50 gr. salt
100 gr. of fat

This dough can be prepared without a fore-dough. Otherwise as the previous recipe. Important is the thorough fermentation of the dough. Baking temperature is 240° C.

Zwieback.

5 kg. whole wheat coarse ground flour.
75 gr. yeast
50 gr. salt.
250 gr. fat.
500 gr. sugar
3 eggs, or egg-substitute.

The third part of the flour is prepared into a fore-dough. The whole amount of yeast and the eggs are added. After a thorough ripening the remaining ingredients are added, and the dough is given a resting time of one hour. After this time it is treated as usual.

Strietzel.

5 kg. whole wheat coarse ground flour.
150 gr. yeast.
50 gr. salt
330 gr. fat
350 gr. sugar.
200 gr. raisins.

The dough is made as usual with a fore-dough and a longer resting time. After baking the bread is covered with a sugar glaze. This recipe can be used also without raisins for rose rolls. Before baking their surface is cut with scissors.

A "Streuselkuchen" can also be made with whole wheat coarse ground flour.

Streusel recipe.

500 gr. whole wheat coarse ground flour
35 gr. fat
100 gr. sugar
a little water and baking powder.

Whole wheat flour keks.

500 gr. whole wheat coarse ground flour
50 gr. fat
200 gr. sugar
10 gr. baking powder

When bread or cakes are made of whole grain coarse ground flour the greatest attention must be paid to its being recently ground. It is important to give the dough a longer resting time, because the flour can swell better, improving the binding qualities of the dough. This results again in the volume of the baked goods.

Bread made of whole grain coarse ground flour is highly recommended. This bread has a longer keeping quality than that of made of white flour and is more aromatic. Fruit bread and Striezel are considered to be delicious. This pastry is not only good in taste but is of great value with regard to its mutritive qualities.

The introduction of this pastry is a new variety in the field of baked goods and taste.

Appendix XIII

Annex 1 to the order of the High Command of the army of Aug. 16th 1944.

Az. 62 k 19 V 3 A (VII 1 f)

Berlin W 35, August 16th 1944
Tirpitzufer 72 - 76

High Command of the army
(Chief of army mobilization and
Commander of reserve army)
62 k 19 V 3 A (VII p f)

Directions for manufacturing and packing front fresh bread.

Front bread is the usual army bread, it is baked according to the same principles as army bread. But in order to achieve a longer stability (protection against mould formation) the bread is made sterile in a protecting wrap. Attention must be paid to the following items:

1) Front fresh breads may be breads put into the oven separately or connected with each other, having a weight of 1.8 kg or - when taking stocks of civilian bakeries - 1.5 kg., they must be packed according to § 2 after cooling well (inner temperature at least 30°). As the stability against mould formation is greater with breads put into the oven separately, these should be used as far as possible. Breads out of shape to a high degree or breads with sharp, widely projecting borders must be removed in order to prevent damages of the packing. A rasping of the sharp spots of the breads in all cases (as with "Dauerbrot" A) (stable bread A) should be avoided in order to save work.

2) For packing front fresh bread, only the pocket packing authorized by the High Command of army should be taken. It consists of two selected paper layers the inner of which is sealed by heating (inside Cellophan AST or Natron-Dublo-Seel, outside brown wood paper). The breads destined for packing are cautiously brought into the bag without damaging it. For this purpose there may be used a putting device,

manufactured of plete or paperboard, one end of which is brought into the unfolded bag. By this device the bread is put into the bag. Attention must be paid that the longitudinal adhesive fold of the bag lies under meath. The filled bags are closed by double folding (breadth of each fold 2-2½ cm). Then the closed end must be put on the bottom side of the bread in such a way that at least 6 cm, calculated from the first cut, lie below the bread. The same must be made on the other side (sealed) of the bag. For this purpose the bread must not be put up to the end of the bag. In order to avoid troubles both the closures are fixed to the bottom side of the bread by means of a gummed stripe. Completely sticking together the closures of the bag is decisive for the stability of the bread. Utmost care must be taken when closing the packing of front fresh bread.

As long as the pocket packings designated by the High Command are not available, the packing of front fresh bread must be performed in the following manner: First, the bread is packed in cellophane paper in the same way as "Dauerbrot (the bottom of the bread is put on the cellophane sheet, the two ends (longitudinal) are rolled together, on the front sides the cellophane is folded, the closures are turned down to the bottom of the bread). Over this wrap there is laid a protective envelope of brown wood paper. (The bread packed in cellophane paper is put with its bottom on the brown wood paper, the two ends of the paper (longitudinal) are also rolled together, the ends are folded, turned upwards to the front side of the bread and fixed by a gummed stripe (4-5 cm in breadth).

3) The packed front fresh breads are made sterile in the same way as Dauerbrot A". This may be performed in ovens having double drawings (Doppelauszugsoefen). When the sterilization is performed in civilian bakeries there may be used, instead of drawing ovens, mechanical

baking ovens (chain-, tunnel ovens, etc.). The temperature of the baking oven is constantly to be kept at 150° C for sterilization Inside the breads the

temperature must be 85° when the sterilization is finished. It is decisive that the necessary temperature is attained in every case in the middle of the breads and that a temperature of 150° is not exceeded in the oven. Should this temperature be surpassed the packing will be badly influenced and the bread will be spoiled. In order to compensate different temperatures in the baking oven the breads shall be laid with a distance (3-5 dm) at the cooler parts of the plate, etc. - these are generally in front and in the middle - but the breads shall be laid close together behind (at the hotter parts). But at all events a temperature of 85° inside the breads must be attained, also at the cooler parts of the oven plate. Higher temperatures inside the breads lying at the hotter parts must be admitted, if necessary. For the determination of the temperature in the baking oven and in the breads the same principles and directions are true as for the manufacture of "Dauerbrot A".

The sterilized breads must be treated carefully in order to prevent damage to the packing and opening of the parts stuck together

4) After finishing the sterilization step the bread must be cooled to at least 25° (inside) before loading into the carriage. Warmer breads cannot be transported and, besides, it is possible with such breads that the closures of the single packings are opened.

   The finished breads shall not be packed into cardboards, etc. Front fresh bread is loaded in the carriages in loose form in the same way as usual fresh bread. Also here special attention must be paid that the packing is not damaged. The breads shall be distributed on the whole bottom surface of the carriage so that sliding about is avoided. A normal waggon can be loaded with 5000-6000 loaves.

5) In order to mark the day of manufacture of the front fresh bread the shaped dough must be provided with a date stamp like the normal army bread. As a stability of the bread of 4-6 weeks is assumed, there must also be indicated the month of manufacture by stamping the corresponding number.

Both numbers can be put together in one stamp in such a way that the number of the month is always last, for instance August 15^{th} = 158. If it is possible to make a period between 5 and 8, this should be done.

If they day of manufacture can be marked on the bag (gum stamp) in the same manner of notation, this is preferred. In this case the bags must be marked before filling.

6) For the stability of the front fresh bread the right packing and sufficient sterilization is of decisive influence. Therefore, special attention must be paid to these two manufacturing steps. Care must be taken by suitable supervision that a sterilization as described is also carried out in the case of the co-operation of civilian bakeries.

(Received from Wuelfeler Brotfabrik
Georg Fiedeler K.G.)

Appendix XIV

Pelshenk Statement on Substitutes

Egg-substitutes for baking

A. Substitutes for whites of eggs (100 % substituting possible)

B. Substitutes for the whole egg (50-75 % possible)

1.) On milk basis.

Using dry skim milk or whey. For the beating qualities, the albumin is important. The seperation of casein and albumin is done by the so called "Quellscheidung", where casein is bound by high swelling material such as pectin, cellulose ether, etc., albumin remains in solution. The casein is got in natural native condition and can be used for further foodstuffs. The remaining solution of albumin has high beating qualities and is dried by sprayers.

If the casein is not separated, chemicals are added such as CaO or tartaric acid, lemon acid or phosphates.

Stabilisers are used for getting better crumb f.i. traganth, carob-bean flour, cellulose-ether. Also baking powder is added.

2.) Blood plasma.

a) Mixed with filling material like starch and with flavor (like Plenora).
Beating qualities sufficient without treatment.
b) Special treating for further cleaning from ash, lipoids and colored substances (procedure of the institute of baking).
No admixtures necessary.

3.) Fish-proteins.

From small fishes by chemical treatment; Admixtures used. Difficult to eliminate the fish flavour.

4.) Plant proteins.

Especially soya and germ used, less suitable for baking purposes.

Appendix XV

Summary of Studies on Rye Baking.

1.) Protein content average in Germany 9.4 % (factor 6.25 wheat 12 %).

2.) Relation glucose: maltose very different in the rye varieties.

3.) Glucose content of the varieties very constant, probably hereditary. Glucose in the average 0.76 % (0.49-2.15), 3 times higher than in wheat.

4.) Maltose content in average 30 % higher than in wheat average 2.3% (1,36-4,34). Rye has higher diastatic values and a softer starch, a lower resistance of the starch to the diastatic attack.

5.) The differences in the gelatinisation-temperature (beginning) of rye starch varied from 40-62° C, average 55° C, German wheat varieties show small differences 57,0-63,5°, average 60,1° C

6.) The height of the amylograms differed between 60-780 units, average 400, the best baking values were found between 400-700 units.

7.) There was no indication that protein of rye changes in quality as wheat gluten does, there is a positive correlation between protein content and water absorption of flour.

8.) Oven spring is very important for the baking value of rye. Most of the volume of dough is not developped during fermentation, but in the baking oven. The low gelatinisation temperature of rye starch and the lower resistance to attack are responcible for it. There is a viscose state of the dough for a longer time than in wheat dough, general speaking 50 % longer. Therefore the characteristic of starch gelanisation of rye starch are very important for the baking value.

9.) On account of these relations, rye flour, stored for a longer time, has a lower baking value. The starch becomes more hard, the gelatinisation temperature is higher, the gas retention in the oven is smaller.

10.) On account of these relations, there is a better result in rye baking by using higher dough weights: here the heating of dough takes more time, the time for oven spring is longer.

11.) Some high swelling constituents of the kind of plant gums are of influence to the baking value. We found that they consist in the greatest part of pentoses, besides small quantities of methylpentoses (7-8%) and 2% galactose were determined.

12.) The main constituents of rye gums are d-xylose and l-arabinose.

13.) A quantitative method was developped for determining the rye gums on the basis of furfurol. Table XXV shows in general an increasing of gums with higher extraction.

Table XXV

Flour Types and Percentage Rye Gums

(Pelshenke)

Flour-No.	Flour type	% rye gums
1	700	2,30
2	815	2,37
3	1150	2,51
4	1370	2,65
5	997	2,81

14.) At the end of sour fermentation, the gums of the rye are not found. May be, that they are nutritive material for sour bacterias. On the contrary, the gums could be determined still in yeast dough.

15.) It seems, that the gums are of importance for the formation of dough on account of their high swelling value of 800.

16.) The aim for getting rye varieties of better baking value must be
a) higher protein content
b) high glucose content
c) good starch gelatination characteristics
d) less inclination for germinating during harvest (heriditary).

Appendix XVI

About the Noxious Bacteria on Leaven.

By A. Schulz.

The bacteriology of leaven does not only consist of the acid forming bacteria, that is the exact former of acid and aroma as well as the yeast, but also deals with the noxious bacteria of the leaven.

It has been possible to isolate a number of bacteria from leaven of different origins as well as from flour and coarse ground flour floatings. These bacteria can be counted among the noxious bakteria of the leaven, proved by baking tests of leaven infected with these bacteria.

These bacteria can be considered to be meal bacteria, as they mostly come over the flour (which contains natufally more or less such microbes) into the dough. First, there is the group of the Coli-bacteria, bactaria coli and bacteria levans, and kinds of mesentericus. Second, there is the group of the ball-bacteria, micrococens pyogenes, streptococcus pyogenes and the sarcina lutea. The bacterium acidi lactici (Hueppe), which are often to be found in leaven, influencing the taste strongly must also be counted among the noxious bacteria of the leaven. These kinds of bacteria which are mostly found in spontaneously fermented doughs, must be examined on such spontaneously fermented doughs and bread baked from such dough. Such bread was judged to be very bad. It had a stale and not sufficiently sour taste. The surface showed strong doughy stripes and had burst largely. The elasticity of the surface was insufficient, the pores set very thickly and irregularly. Strong formation of bubbles mostly caused the breaking off of the crust from the bread. Even the brown of the color of the crust differed. All tests made with such spontaneously fermented dough showed the same results.

In order to examine the single noxious bacteria, these were first grown in a nutritive solution, and added in a proportionally high concentration to a dough, which consisted of 150 gr. flour, 120 ccm water, and 1.5 gr. leaven - yeast. After 24 hours fermentation 150 gr. flour and 120 ccm water were added to this mass. It was considered that the bacteria had fully developed in this dough after this treatment.

That means, that on the fourth day this dough was considered to respond to a normal leaven.

Bread with bact. acidi lactici was disgreeably sour in taste, and had a strong odor. The formation of the pores was irregular.

The bacteria, belonging to the group of the coli-bacteria caused a stale and bitter taste. The bread clumped strongly, when chewed. This group of bacteria has a strong influence on the taste of leaven. Sarcina lutea caused a weak elasticity and irregular set of pores. The taste remained pure, but the bread clumbed, when chewed. The same is to be said about bread containing Micrococcus pyogenes, though the elasticity was better. However, this ballbacteria caused a stale taste and irregular set of pores.

Streptococcus pyogenes gave a bettér baking technical result. The taste was pure, though not sour enough. As with all the other ball bacteria, the pores were set very thickly and irregularly.

The qualities of development of these bacteria in leaven had to be stated. Therefore, they were added to leaven. At hand of previously made tests it had been stated, that the bacteria of leaven, forming the aroma and acid, stopped the developing of the noxious bacteria in leaven in the amounts they normally occured on flour. In most cases the development of the mnoxious bacteria was completely oppressed. On the other hand it was stated that if the fermentation leaven was not strong or ripe enough, or the fermentation of the whole dough was weak, the noxious bacteria caused unfavorable changes in taste. A good dough could be obtained when such faults were avoided. Even the infection by addition of noxious bacteria to the leaven and their influence could be oppressed by the acid producing bacteria of leaven - though not completely - because of the short time of fermentation. Infections as used in our tests can never occur with flour only, and on the other and the acid producing bacteria are able to oppress the concentration of the noxious bacteria as far as they are normally present in flour. That means that the acid producing bacteria of the leaven are on the whole able to oppress and keep tha leaven clean from the noxious bacteria.

Appendix XVII

The Influence of Baking on the Chemical Composition of Bread.

By Dr. A. Rotsch.

The examination was made with whole rye bread = Roggenvollkornbrot, which was prepared as normally in leaven, but baked in two different ovens at differet temperatures. One of the ovens was a special oven heated with steam, resulting a temperature of 90 - 100 deg. C. The second oven was a common oven, heated with gas. The baking time in the first oven was 4 1/2 hours, in the second 2 1/2 hours at a temperature of 200 - 230 deg. C.

Both the breads were examined for moisture raw-maltose and soluble starch. The moisture was expressed in the well known method of stating the losses in weight of a piece of bread after drying at 105 deg. C.

The reducing sugar, known as raw maltose was stated by the Bertrand method in 10 % bread extraction cleared with lead-tannat. For the statement of the soluble starch an appropriate modification of the method of Baumann-Grossfeld was used: 50 ccm of an uncleared 5 % bread extraction was mixed with 3 ccm of 25 % hydrochloric acid and heated 15 minutes in boiling water bath, then cooled, 20 ccm 25 % hydrochloric acid and 5 ccm phosphorous tungstic acid natrium (phosphorwolframsaures Natrium) added, filled up to 100 ccm, mixed and filtered. The filtrate was polarized in a 20 cm pipe. The turning of a 5 % bread extraction cleared with lead-tannat, which was treated in the same manner, was stated, and out of the difference of both the turnings, multiplied with 5.444, the content of soluble starch was found. Raw maltose and soluble starch were calculated into dry substance. The following table shows the results:

	Composition of bread baked at temperatures of:	
	90-100 deg.C.	200-230 deg.C.
Water	48.7 %	48.5 %
Raw maltose in dry substance.	7.8 %	5.6 %
Soluble starch in dry substance	7.1 %	6.2 %

These figures show the decomposition of the bread baked at low temperatures against the second bread, baked at normal oven temperature. The increase of the content of soluble starch is undoubtedly caused by the longer baking time, but the increased maltose content can be explained with the longer activity of the enzyme, resulting through the lower baking temperature In the second bread. the high temperature soon stopped the pulling down of starch activity of the enzyme. The better decomposition of the bread is of course an advantage, but this bread had no crust, because its formation requires a baking temperature over 100 deg.C.

Appendix XVIII

About the Composition of Bread Showing Doughy Stripes. (Wasserstreifen)

By Dr. A. Rotsch.

The examination was made with old rye meal, which showed the following results after chemical examination:

water	13.00 %
raw maltose	2.67 %
starch	69.40 %

The examined flour was of the type 1150. Prepared as leaven it could be baked fairly well, but prepared with yeast it showed a strong doughy consistency in bread, so that it could not be used. It was necessary to examine the composition of the bread in both cases. In the supposition that the difference in the composition occured mainly with the carbohydrates the tests were limited on the statement of starch and reducing sugar, which occured as maltose and glucose, and on the water content.

The results of starch and sugar statements were calculated into dry substance. The following shows the difference between the normal and the doughy bread.

	Normal bread	Doughy bread.
water	41,3 %	47,7 %
glucose in dry subst.	1,9 %	1,9 %
maltose " "	8,8 %	9,6 %
starch " " "	68,3 %	53.3 %

It is striking, that the water content of the doughy parts is increased but this does not occur always. The reducing sugar content does not show a great difference, but the decrease of starch for 15 % in the doughy bread is noticeable. The reducing sugar content in the doughy bread is not essentially increased against the content of the normal bread, so the decrease of starch could have only lead to an increase of the dextrines, which cannot be exactly specified by analysis. This is also the opinion of N. Kosmin that doughy parts in bread are caused by an increased activity of the dextrinogen-amylase. The activity of these enzymes in bread and pastry, made of sprouting flour

decreases the starch into dextrines, loosing its quality of coagulation and absorption of water during the baking process. This unbound water leads then to the doughy spots and parts. As this appears especially with yeast doughs, but seldom with leaven it is presumed that the leaven activity stoppes the activity of the dextrinogen-amylase. But it cannot be a pure pH effect, as the optimum of the dextrinogenamylase is more to be found in the sour area, that means that the decrease of starch should be expected more in leaven than in yeast-doughs.

A satisfactory explanation can be only given after a thorough examination of the fermentation products of leaven, of their enzymeoppressing or activising effect, which must be investigated.

Appendix XIX

Tests about Rye-gum. By Dr.A. Rotsch.

It is known that rye flour differs from wheat flour in its conduct when mixed with water. Whereas wheat flour is easily floated with water, rye flour forms larger and smaller clumps and it is difficult to produce watery suspensions. Filtrates of wheat flour-suspensions are thin and filtrate very quickly. Rye flour floatings are very viscous and filtrate very slowly. The different times of filtration can, after M.P. Neumann, be used for determination of the mixture relations in rye and wheat flour mixtures. The cause of the viscosity of rye flour extractions is a substance belonging through its chemical nature to the hemicelluloses, gums or plant mucus, which is contained in flour as a dry gel, but in watery floatings swells strongly and forms a tough, fluid sole, depending upon the concentrate. Wheat contains also a similar substance but in smaller quantities and different qualities.

The first investigations on this rye-slime was made 10 years ago, by Berliner and Ruter, and gave some data about its chemical and physical conduct, which were confirmed afterwards by Rotsch and Pietz. But the chemical composition of this substance and the role it played in the fermentation and baking processes could not be determined. As far as it is known, this rye-slime is a pentosan-containing intercellar substance which is precipitated in the form of slimy threads by alcohol or acetone of watery solutions, strong optical left turning, but posesses right turning after inversion with strong acids. In both cases it is not fermented through yeast, and reduces Fehring's solution only after inversion. The hydrolysate gives clear pentose reactions and a weak methylpentose reaction, whereas hexose could not be found, so that it was concluded, because of the negative yeast fermentation test, that hexose was not present.

Very little was known about the baking influence of these substances in the fermentation and baking processes

Fellenberg thinks that these slime-substances of rye explain why no gluten can be washed out from rye flour as he could prove that this happens also with wheat flour, if 2 % of this rye-slime is added to wheat flour. He explains it so that the great swelling qualities of this slime substance absorbs the water that is necessary for gluten to swell. Later tests of Rotsch and Pietz showed, that in rye bread, made of leaven no slime substance could be proved, but bread made with yeast mostly showed the slime-or gum substance unchanged. But later tests showed that the rye-slime was, nevertheless, sometimes to be found in bread made of leaven. Occasional-ly its presence could be proved in bread (made of leaven) though not in the same amounts as in flour. It had to be found out how far flour ferments being activized by fermentation, were responsible for the decrease of the slime. So flour floatings were made, were held at temperatures of 27 to 30 deg. C for times of 3,6,18, and 24 hours, and were examined on their content of rye-gum. Not one of these cases showed any noticeable decrease of the rye-gum. Also the changing of pH on the sour side did not give different results. It seems that the activity of flour enzymes does not influence the decrease of these slime or gum substances.

The following tests examined every stage of the fermentation of leaven and at last the baked bread on their content of rye-slime. Strangely enough, it was found that in every single case the presence of this substance could be proved through precipitation with acetone or alcohol. It was concluded that the decrease of the rye-gum is caused by certain bacteria, which are, if not always, so mostly present in leaven. It was possible to decrease strongly with two kinds of bacteria, isolated from the leaven by A. Schulz the rye slime which was precipitated with acetone, and again dissolved in water, in an approximately short time (24 Hours). As fermentation product (beside a small acid formation, a gas mixture could be stated, which consisted partly of carbon dioxide and partly of hydrogen respectively of methane. Thorough investigations of this fermentation process are still in work.

For chemical examination it is necessary to separate the protein from the slime substance. The precipitation of the protein can be made by using tungstate - sulfuric acid or dialized ferric oxide. The use of the first gives a colorless filtrate, the second gives an often yellow colored filtrate. In both cases the precipitated slime must be again dissolved and precipitated, because of a further purification. In such rye-gum, being precipitated twice, no amount of nitrogen could be determined by using the nitrogen determination method of Kjeldahl.

The obtained substance was vacuum dried at a temperature of 60 deg. It was examined on pentose by the "Barbitur" acid method and by the phloroglucin method, which results an approximate determination of methyl-pentose. With part of the substance a slime acid reaction on galactose was repeated, which formerly had given negative or uncertain results.

Fermentation tests with the hydrolysate were also repeated and compared with solutions of glucose and galactose, that had been fermented with the same amount of yeast. The hexose-reaction with skatol after Dische and Popper, which in former tests had been positive, were also repeated. The fermentation test was negative but the galactose solution did not show any noticeable traces of fermentation, whereas the glucose solution showed already after a few hours a strong gas separation. These tests prove, that the common yeast, as used in bakery is not able to decrease galactose. The result of the fermentation test cannot be considered as a decisive proof for the absence of hexoses. But the presence of galactose could be proved undoubtedly in slime acid reactions, as a small amount of slime-acid cristals could be proved microscopically through a reaction with thallium nitrate after van der Haar.The slime acid cristals could be distinctly distinguished macro- and microscopically. It was now tried do determine the quantity of galactose after the method of van der Haar. An amount of 2% of dry slime substance of galactose resulted. This explains the positive results of the hexose-reactions after Dische and Popper which were made with solutions of glucose, froctose, galactose, arabinose cylose, and rhamnose, besides being

examined with dextrin. This procedure was found to be very reliable and its calorimetrical use for determination of galactose in rye-gum seems to be possible.

The pentose determination after the barbitur-acid method resulted a value of furfurol of 37,0, which gives 70% of pentosan (when calculated on pentosan). The barbitur acid value was for about 3% lower as the furol value, determined after the phloroglucid method. The in alcohol soluble part of the phloroglucid sediment gives a content of 8,7 % of methylpentose (calculated as rhamnose).

But it was not yet possible to identify the methyl pentose. It cannot yet be said, if the positive acetone test on methyl-pentoses, which results of the rye-slime already in not hydrolized condition, is to be led back on the content of rhamnose or on another still unknown methyl-pentose.

Identification tests of pentose, contained in rye-gum, showed that xylose (after the method of Widtsoe and Tollens) could be undoubtedly determined in the hydrolysate as xylon-sour cadmium-brom-cadmium in the cheracteristical boat-shaped form of the cristals of this double-salt. It was far more difficult to prove the presence of arabinoses. Test, cut with diphenylhydrazin, the characteristical hydrazon of arabinose, failed, but arabinose could be proved as benzylphenylhydrazon. The examinations on uron acid were negative.

The preliminary tests gave the following results:

1. The slime or gum intercellular substance of rye flour is composed of (approx. 70%) pentose, 2% galactose and small amounts (7 to 8%) of methylpentoses.
2. The decrease of rye-gum in leaven fermentation are caused by the activity of certain pentose fermentation causing bacteria, which are mostly present in leaven. The chief fermentation products are gases, consisting in approximately the same proportions of carbon dioxide and burning gases hydrogen, and methan.
3. The pentoses of rye-gum consisted chiefly of arabinose and xylose.

Appendix XI

List of applications for the climatic chamber

rubber for field wiring,

artificial plastics for field wiring,

ammunition,

voltmeter, ammeter and any indicating and measuring instruments, going into aeroplanes, tanks, U-boats and ships,

radio locating equipments for aeroplanes and tanks,

general chemical products,

paint and lacquers, glue,

packages and wrappings of artificial leather,

artificial wood and press-wood,

metal-alloys, especially aluminum-alloys,

impregnated fabrics, for inst. weather proof textiles,

testing medical dressings unter climatic conditions,

testing canned food,

seed testing unter climatic conditions,

testing of keeping quality of fruit and food,

testing apple-pectin,

testing lignite briquettes,

testing breakage of lignite briquettes under climatic conditions (important for synthetic gasoline-production)

testing graphic paper for recording instruments,

testing micrometers, gauges and calibration equipments, tools under climatic conditions,

oils and fats,

films and general photographic material, general medical instruments.

APPENDIX XXI

Investigations of the Institute for Food-Research, Munich

(Translated of a statement written by Dr.Heiss, Director)

The Institute for Food-Research in Munich was founded in 1941 with authoritative support from the German Food and Packing-Industry. This association had set as its task the improvement of such food manufacture, which is behind in food hygiene. The trends of work are similar to those of the Massachusetts Institute of Technology.

Investigations are made on those food-stuffs, for which there are no research institutions in Germany. No investigations are made on milk, fermentation or corn manufacturing industries. Food manufacture is closely connected with its keeping quality, so the keeping fresh of food is one of the chief tasks to be faced. The Institute has no commercial interests.

The Institute began its work in Autumn 1942. In the foreground stood the improvement of quality of different foodstuffs. Of great interest was the production of heat stabile foodstuffs.

Improvements in quality:

This subject being the freezing and dehydration of food. The importance of freezing is based on the fact, that through freezing the natural qualities of the foodstuffs are best preserved.

The fundamental question about the influence of the rate of freezing on the quality of frozen fruit and vegetables was solved. It was found that with the exception of tomatoes and cucumbers it is unfavorable to freeze very quickly, - on the other hand, - slow freezing must be avoided also. It was further determined which fruits must be covered entirely with sugar solution, and which could lack sugar solution partly or completely, or which could be manufactured with dry sugar.

It was tested whether berries (in case of large crops) could be stored in sugar solution at a temperature of -4°C to -8°C without essential changes in taste and vitamin C content. The only difficulties in this direction were found with sour cherries. Finally it was ascertained, in which cases fruit and vegetables permit an after-storage at normal temperatures (room-temperatures). Fruits can be stored quite well 24 hours in sugar solution. But this does not work with all kind of vegetables. Finally, the loss of taste and vitamin-C content was

investigated after a storage of one to several years at temperatures of -15° to -17° C. It was found that only with a few exceptions (sour cherries, paprika) the vitamin-C content can be preserved extensively. Preliminary experiments were made on the influence of different oxygen concentrations on strawberries and peaches. Very small oxygen concentrations produce a grassy taste, very high oxygen concentrations develop after-tastes. The change in fat composition which probably causes the change of taste, must still be investigated. The extent of the penetration of sugar solution into the fruits was investigated and the boundary concentrations, depending upon the rate of weight of sugar to fruit ascertained. The penetrated amount of sugar could be ascertained mathematically in case of a slight but diminishing resistance on the surface of the fruit.

Oranges and orange juice become bitter when frozen. To avoid this, two possibilities are given:

1. The separation of the juice from the pulp.
2. By changing the pH value, the acid-and sugar concentration, especially through thickening by adding sugar.

At the same time tests were made to debitter orange juice, which had already become bitter.

Tests were made on the influence of katalase-activity in peas and potatoes, caused by freezing speeds and storage temperature, in order to explore deeper the changes caused by freezing. Results found through organoleptic examination could be confirmed. It was found, that the enzyme-molecule is more damaged the lower the storage temperature and freezing velocity.

The freezing acts in a specific way on the enzymes, therefore, it depends upon the test conditions whether they are activated or destroyed. These tests were continued.

To give the industry a general picture on improvements in and the level of quality of common frozen products, 1941 and 1942 comparative quality tests were made, which were later continued by the appropriate chief association. They led to establishment of delivery conditions for frozen fruits and vegetables.

The documents on the changes of frozen lean fish were lost during the burning of the

Institute in 1943. The tests showed a correlation between consistency and the measurable chewing pressure. It seems that salting has a favorable influence upon the preservation of the delicacy and the succulence of the fish, probably a fore-storage to 3 days is also favorable. During refrigerated storage, the giving off of a certain tissues moisture of the fish increases; the consistency deteriorating only slightly. Slow thawing is very deleterious for frozen fish fillets, the same being the case when the fish is not used immediately after cooking. This is the reason why frozen fish tastes tenacious and straw-like.

In conjunction with the "Reichsbahn", tests were made, and the accumulation of warmth and warmth penetration number for the most important transportation vehicle types were fixed. This was necessary, because the transportation of refrigerated food had to deal with the amount of ice needed, to compensate the penetrating warmth and the storage warmth. Conformity to law, requirements of the refrigerated transportation vehicles were studied, with regard to local layers of temperature. The temperature fields can now be mathematically predicted. Good insulated cars ought to be used for longer lasting times of transportation, and for susceptible frozen goods, not only to save the means of refrigeration but also for decrease of the differing local temperature layers. The accumulated warmth- to be exhausted - can be kept low by means of a self supported shell construction.

Finally, the requirements of raw material for construction of the different kinds of refrigerators and the requirement of workers for their maintenance was compared. The Birdseye plate refrigerator was considered to be the most favorable. It was found that packaging with too high resistance to penetration of heat must be avoided with increasing velocity of freezing. The application of this point of view led to a decrease of freezing time of 25%, whereas the packaging has no essential influence on the efficiency of the refrigeration apparatus, when freezing in circulating air is used. At the same time it was found that fat meat shows quicker freezing time than lean meat. The result was explained theoretically.

Vegetables must be blanched for both dehydration and refrigeration. Unfortunately, blanching is accompanied by a loss of nutritive and other substances. To avoid greater

losses, blanching times just sufficient for inhibition of enzyme activity had to be found and quick tests made. Inactivation curves for peroxydase were formulated and the determined blanching times compared with the results of taste test. Further the oxydation of ascorbic acid was studied and it was found that it can be stopped by the influence of heat. The technique for determining the effect of dehydration on plants upon fresh blanched and dehydrated vegetables was used.

A beginning was made to define the characteristics enzyme systems of the "Proteasen" and "zellulasen" types in plant tissues. The regeneration of Peroxydase proved to be dependant on the ferment concentration, temperature and time of heating, which means that the correlation between pure ferment and plant tissues was parallel. 5) Tests were made to define the group of substances causing the discoloration and change in taste of dehydrated vegetables during manufacture and storage.

To procure a quick test for judgement of the correct blanching times by the use of guaiacol a method was developed and compared with Diemaier's reaction for blanching process and results of taste tests after dehydration and storage.

Attempts were made to replace the method of checking the inactivation of ferments by blanching through other processes which would be accompanied with less losses of nutrient substances. This attempt had no result. The ferment systems of peroxydase, the ascorbic acid oxydase and dehydrase proved resistant against ether and alcohol (in quantities of 5 %) and was not to be checked.

Winter cabbage, cabbage (curly), kohlrabi, beans, potatoes, cabbage and carrots must be blanched, whereas red cabbage, mushrooms, sauerkraut and spinach ought not to be blanched. With the exception of red cabbage, which must be dehydrated at as low temperatures as possible, a dehydration temperature of 55° seems to be optimum; for mushrooms and potatoes higher temperatures can be used. The loss of carotene in dehydration of carrots proved to be very small. However, during storage the carotene vanishes nearly completely if not stored at refrigeration temperatures or in inert gases.

Most kinds of vegetables show only slight changes after sensible dehydration. Perceptible are these changes only with cabbage, beans, spinach and carrots. All kinds of dehydrated

vegetables show after lengthy storage considerable changes if they are not stored very dry. That means, that for mushrooms and spinach the water content limit can be at about 5 % whereas for beans it is about 15 %. The changes in carrots cannot be stopped even at very low water content of the air, if they are not stored in inert gases. On other kinds of vegetables the influence of the oxygen of the air is secondary with regard to changes during storage.

For guidance on the quality standard of dehydrated vegetable products, one hundred different 1 year old products were comparatively examined, whereby it was found that the number of unsatisfactory products, especially sugar beet leaves, red cabbage, sauerkraut, spinach and cabbage (curly) was very high, whereas cabbage and carrots took a medium position; beans and julienne potatoes were mostly judged to be good.

Considering all factors, it seems possible to produce dehydrated vegetables the quality of which is nearly as good as that of fresh products. Therefore, it is important that for dehydration and refrigeration of the most important kinds of vegetables the processes be coordinated according to season, so that the combination of the refrigeration and dehydration processes results in a better utilization of the factory.

As the determination of vitamin-C content in dehydrated products shows considerable faults, the vitamin C estimation was improved by means of the Lange-kalorimeter; further investigations were made to separate the vitamin C in a specific manner. This can be done over Osazon. However, this method is still unsatisfactory in measuring quantitatively.

It could be proved, that by dehydrating potatoes for manufacture of potato-flour (Kartoffelwalzmehl), iron passes over in an amount of o.o5 %. It was found through systematically made tests, that the addition of this amount of iron to steamed potatoes causes discoloring, the intensity of which is dependant upon the time of steaming.

The possibility of improving the quality of spread for bread by adding natural, respectively artificial vitamin C (vitaminizing) was investigated. Marmalades, vitaminized by means of Hippophae Rhamnoides (Sanddornbeere) concentrates, showed no vitamin C loss after longer time of storage, assuming that the concentrates were cooked together with the marmalade for a short time. Vitaminized

artificial honey showed the same result. But tests with drops (candy), vitaminized with synthetic ascorbic acid, proved that for preservation of the vitamin C content, a p_H = 5 is necessary and that a higher p_H value results in a quick decrease.

<u>Improvement of keeping-quality, especially at high temperatures.</u>

The problem of the influence of high temperatures and air moisture was prompted by army requirements in warm countries.

Our nutrition is founded on potatoes, which are stored chiefly in stacks. The insulating effect of the covering layer was experimentally ascertained in a model-stack, heated with electricity. The warmth balance showed, that a considerable amount of warmth escaped through the bottom part of the stack. Tests with a filled potato stack made it possible to specify the respiratory warmth for the whole time of storage. Numerically the penetration of heat through the covering layer was little influenced by atmospheric conditions. It is necessary to use, especially in spring, stack thermometers to avoid losses in practice.

<u>Storage of eggs in lime-water</u> was of further interest. If the freezing point of the preserving liquid is (by addition of salt) regulated to - 0.8°C, the water absorption of the eggs during storage could be reduced to a minimum. The suggestion to improve the keeping quality of eggs by dipping them for a short time into hot water had no positive result, as proved by illumination (candling) and keeping capability. The loss of weight was decreased by immersion into hot mineral oil, besides causing an improvement in preservation of the taste. Whereas a keeping time of 8 weeks even in warm and moist climate, resulted if the eggs were dipped into 60° warm mineral oil, supplied with bacteriacide (6). The bacteriacide being volatile, it is necessary to furnish the egg boxes with gas protection bags.

<u>The keeping-quality of preserved bread</u> is often deficient because too high sterilisation temperature results in the cracking of the wrapping-paper, - on the other hand - the microorganisms are not destroyed if too low a sterilization temperature is used. Therefore it is the chief problem in manufacture of preserved bread in non-metallic packagings, to find the necessary destructive temperature. Uncontrollable temperature zones in the sterilization oven and deficient sealing of the packagings are often the chief causes of losses. The thermal death time

temperature of several mold spores, often found on preserved bread, was determined. After incomplete sterilization a liquid appears on the bread. This liquid stops the growth of the spores.

The usual packaging of spices has the disadvantage, that the aroma is lost. By means of a test apparatus developed by the institute, different packaging materials were examined with regard to their perviousness to odorous substances. Only aluminum and Luvitherm foils proved imperious. Of extensive density were lacquered parchment and duplo-paper, especially produced mechanically in the shape of flat bags. Methods of measuring were also communicated to the industry.

The transportation of fat in summer causes considerable transportation losses. Instead of laying-out the boxes with parchment, lard was poured out in bags. Difficulties arose in densifying the seams. The use of agglutinated seams can eliminate these difficulties. The seam_less two-layer bags guaranteed in summer the highest degree of security, especially in transportation. The inner layer of the bag is made of weather-proof Zell-glass, the outer layer is made of parchment substitute with hot agglutinated inlet. In winter one-layer bags of parchment or parchment substitute are sufficient.

The transmission of light through the papers used, plays a great role in the spoilage of food-stuffs, containing fat. The transmission of light increases with zellulose-paper of increasing milling degree. In addition the transmission increases with increasing length of the waves.

Tests on the keeping quality of tuna fish showed that it could be kept several weeks in good quality only at a temperature under minus 20°, with an abundant addition of solid carbon dioxide. Quick spoilage is probably caused by enzymatic influence.

As far as fat is concerned, the question had to be decided, if canned butter ought to be stored in rooms of cooled or freezing temperature before transportation to warmer countries. The test proved that in freezing temperature prior cooled butter endures the following storage at high temperatures better though it becomes easier oily. Several possibilities were examined to obtain durable and warmth stable tropical fats. Mixtures of butter and margarine proved to have the best qualification for these purposes, as they could still be spread at a temperature of 35°C. The keeping quality nearly reached that of the margarine used if the mixed butter was chosen correspondingly. The autoxidizable of fats in emulsions were studied for the pur-

pose of observing the spoilage of fat in presence of biological catalysts under physiological conditions. The gave completely new conceptions about the effect of katalase, which not only stops the autoxidizable of fats, but can strongly promote it in presemce of traces of minute amounts of certain metals. Through freezing at the same time a change in the direction of the influence could be obtained.

The major precautions to combat the spoilage of foodstuffs. The keeping quality during transportation, is connected with the solidity of the packaging. The highest resistance of packaging materials resulted mostly at a relative moisture of 65 %. A decrease of relative moisture to 30 % increased a little the tearing length and cracking compression of the packaging material but decreased strongly its tension. The paper becomes brittle and therefore less resistant against mechanical requirements. A moisture over 65 % improves the tension and flexibility, but reduces the tearing length and cracking compression so strongly that the general result is worse than at 65 %. Lacquer protected packaging materials also are no exceptions, only the balance sets in more slowly.

The problem had to be solved of impregnating the packaging materials so that the quality of resistance remains constant over an extended resistance range, as it is with Luvitherm and Igelith foils. Further it could be proved, that the existing glue streaks strongly suffer with regard to their adhesive properties, after longer storage in moist atmosphere. Therefore they must be stored steam-tight or at low moisture.

Saving of transportation space. Because of a lack of transportation many products, as for instance melted cheese, marmalades, eggs, tomato purree etc. were dehydrated. These products have a future. In the production of dehydrated meat the influence of the ripeness, dehydration temperature, velocity of dehydration, degree of dehydration, mechanical and chemical fore-treatment before swelling, influence of time of swelling, water temperature for swelling and storage conditions had to be studied. Dehydration temperatures between 4o and 5o° proved to be the most favorable. Demonstration of the connection between saving of the weight of foodstuffs by dehydration and the changing of the water content resulted, that practically it is the same if you dry to a water content of 5 % or

from a water content of 20 %.

This brought the suggestion not to over-do dehydration in order to preserve the flexibility of the meat fiber; but this staple product must be canned. A considerable amount of tin is saved by this method. On the base of this concentrate, a dehydrated meat treated with spices and brown flour was developed.

The extraction of water is only one of the means of saving loading space. The optimum is reached only when the specific weight of the loading goods corresponds to the proportion of loading volume to loading capacity The proportion amounts for a plane approx. 15o kg/cbm, for a 3 ton truck approx. 315 kg/cbm, for a 4,5 ton truck approx. 24o kg/cbm, for railway-cars between 354 and 424 kg/cbm, for shelter-deck ships 42o kg/cbm, for tankers 77o kg/cbm. According to which of these means of transportation are used, it must be tried to compress dehydrated goods. A too extended decrease of volume would be useless, as it would only cause the increasing of the free air space in the loading room, since unpressed goods, particularly flour, packed in sacks, do not even save packaging materials. In practical tests the admissible pressure for each of the goods was ascertained. It was suggested to replace the voluminous form of some foodstuffs by a space saving shape, as, for instance, noodles (o,2 t/cbm) by horn-or star-like shapes (o.46 t/cbm). Vinegar essence with a packaging share of 25o % was replaced by crystallized citric acid, being with respect to taste and also physiologically the best substitute for vinegar. Hereby a 62 % saving of tare was obtained.

The production of fruit-juice concentrates became important. It was caused through a lack of bottles. The losses during storage with regard to nutrient substances, mineral and flavorstuffs in citrus juices - differing in the strength of concentrates and storage temperatures, - were first examined. Bacteriums, bacillus and spore forming yeast showed at certain p_H ranges a marked germ retrogression. It could be proved that orange juices practically preserve their vitamin C content in any concentration and at any temperature, as long as they do not decrease too much in taste. For longer spaces of time even highly concentrated juices are not storage-secure at common temperatures. It is recommended to use temperatures between -6° and -8° C.

Saving of raw materials.

With the duration of the war certain raw materials became scarce and the question arose how to replace them. The greatest need was felt in packagings - the lack of iron and later the lack of fibrous materials.

Marmalade was thickened more than usual, poured out into bags similar to those used for fat, as described previously, which were in wooden boxes secure for transportation. The bags had to be of such a height, that the overlapped parts had a length of 6-8 cm. It is important that their proportions correspond to those of the boxes.

Dehydrated foodstuffs have the disadvantage, that they change their water content according to the partial pressure of water vapor of their surroundings, if they are not hermetically sealed. The packaging of hygroscopic goods depends upon the velocity of moisture absorption per unit of weight, volume, and upon the critical moisture interval, that means the relative moisture, causing unpleasant changes. With some dehydrated goods this range is low; they begin to coagulate becoming insoluble; others change enzymatically at low contents of water, for instance dehydrated vegetables, and other goods are endangered by molding. The saving of packaging materials must not be made at a sacrifice of the spoilage protection of the goods, so the packaging had to be adjusted to the requirements of the foodstuffs. Therefore the hygroscopic conduct of the individual foodstuffs had to be studied; further the qualities of the most important packaging material, and of it manufactured containers had to be examined. It was found, that the limit of the growth of mold spores lay at 20° C(with a great many of foodstuffs between a relative humidity of 77 and 82 %), some sweet goods showing in a fresh production state an equilibrium moisture very little below it, so that they are endangered even with a small increase of moisture. Here a recipe change is recommended. The hygroscopic conduct of a great many of dehydrated goods as: deh. vegetables, deh. potatoes, yeast powder, milk powder, egg- and cheese powder, apple and tomato powder, pudding-powder, scald-cubes, coffee etc., was studied. To a large extent the steam-tightness of new developed papers as for instance waxed Zellglass, Duplczellglas, softened Igelit foil, lacquered pergamine (sort of parchment, or parchment-like paper) etc., was determined.

For large packagings of artificial honey pergaloid was suggested. One layer with 65 g/sqm is sufficient instead of 2 layers of parchment substitute.

As these foodstuffs were delivered chiefly to large consumers it seems unnecessary to manufacture the individual packagings steam-tight. It was suggested to manufacture the individual packaging in the manner that only the contents were held together, but that the whole slupment be in a large bag of steam-tight material. The steam-tightness of these large packings could be improved by one third, because it had only a small number of sealings - also,the advantage of these packings was the saving of a considerable amount of fibrous materials. The closure of the inlay bag by simple folding showed only a little less steam-tightness than the sealing of the closure, so that this troublesome procedure could be given up.

In cooperation with the refrigeration and packaging industry suggestions were worked out for saving of packaging material in the packing of refrigerated goods. The admittable smallest valence fof wet-bursting-pressure and the wet-rigidity of packaging card-board for refrigerated goods were ascertained and the numerical relation between wet-rigidity of Eco card-board and the maximum changes of the form of Eco card-board packagings during melting were found. Eco card-board mixed with 3o % of mechanical wood pulp has a higher we rigidity, than a card-board free from wood cellulose.

With preserved bread a number of foldings was studied and it was found that it is unfavorable for the sealing-density when all the seams are sealed before sterilization. A bread of 6oo g weight has to evaporate 33 l of steam and an amount of 2oo cbcm air. Therefore is must be possible for steam and air to escape during sterilization. The final sealing ought to be made only after sterilization. The best sealing of the narrow side was triangular overlapping, the long side was closed by means of a confectioner's fold or by a single overlapping to a breadth of 6 cm of the overlapping parts.

For mustard, luvitherm laminated boxes proved to be sufficient in continental climate. For yeast extract, inside lacquered 1/1 card-board boxes were sufficient in continental climate and average moist climate. But seamless bags of weather-proof Zell-glass containing 8oo cbcm proved to be better. Until solidification these bags remain in form boxes, made of wood. Then the packages

can be placed in supporting cartons, and in a greater number in cartons, made of card-board or packed into boxes. The tin drum for skimmed milk powder could be replaced through a steam-tight inlay bag. The product Milei-W suffers strong changes when exposed to the influence of high relative moisture so that the packaging of this product hardly can be managed without metal-foil. The manufacture of preserved bread was also hardly manageable because of lack of raw materials. By replacing of aluminum-foil through Duplopaper the keeping quality is not decreased, but drying is increased. But when only one layer of Zell-glass instead of two is used, the keeping quality decreases considerably.

Tests made in cooperating with meat curing and smoking establishments and packaging industry proved, that smoked goods packed in cellophane AST, Pliofilm, Duplopaper and bitumenized Manila Kraftpaper, the growth of mold spores at a temperature of 30o C and a relative air moisture of 95 % could be avoided for 6 weeks, when the sealing was made steam-tight. A far better keeping time could be obtained by packaging in zinc foil, limonated on pergamin, on cellophane AST, or on Luvitherm. Of course the zinc foil had to be protected against corrosion through appropriate lacquers. 12)

For the packaging of marmalade 13) a box (besides the inlay bag) was developed on fibrous material base. It was found that the water vapor density of these boxes ought not to exceed 40 mg/dm^2 and per day, the highest being 15o mg/ if the changes in quality should remain bearable. If the in- and outside lacquers are so chosen that the box becomes water-proof, this can be done by furnishing the boxes with a steam-tight inlay bag.

Tests were made to solve the question as to which degree of porosity porous aluminum foils can be used. These tests showed the connection between perviousness of water vapor and the number and size of the boxes, as well as the influence of lacquering and limanating.

A comparative examination of the construction of dehydrators used for potato slices and vegetables showed that belt and turbine dehydrators have throughout higher manufacturing requirements than most of the drying room, cabinet and tunnel dehydrators. Only a few constructions require less iron, energy, employees, basal surface, space and

primary costs (specific requirements), as are the Igetro-cabinet dehydrator S4, Igetro-Hordenwagen dehydrator D8 and the air changing "Wanderhordendarre" Paracelsus, which are the dehydrators of the future.

Food Scarcity.

With food scarcity arose the question which by-products could be used for human nutrition, particularly how waste products could be decreased. The average percentage of waste products in manufacture of dehydrated potatoes is 30 %. The heat peeler used in the U.S. was completed so that the blanching of potatoes was done before heat peeling takes place. Hitherto the slices were peeled causing great losses through leaching. The method, constructively developed by Schulte, resulted in a decrease of losses through peeling from 27,5 % to 4,2 %, losses of starch from 34.2 to 9.2 %, loss of vitamin C from 65 to 12 %, and loss of protein from 43 to 12.4 %. After constructive improvements at the end of May we succeeded in producing a dehydrated product of potatoes of medium size, yielding 21 % with a water content of 14 %.

A similar decrease of losses by leaching is expected through tests as described with vegetables. The most favorable blanching times must be fixed.

To the available food-reserve must be added the large quantities of coarse rape from oil extraction. It contains 35 % protein. Obstacles for its utilization in human nutrition are its content of bitterstuffs and mustard oil. Specialists thought its removal impossible, but nevertheless two processes were found

A process than can be used even in households, with a leaching out percentage of 2o %.

An extraction process yielding debittered coarse rape without losses.

Raw material, insufficiently valued, are chestnuts. Their decentralized extraction is caused by unfavorable transportation conditions. Utilization processes are known, but until now the chief attention was paid the yield of Saponin. Following methods can be specified.

1. Production of chestnut starch in starch factories.
2. Debittering with soda lye or other alkalies, in starch or sugar factories. Debittered flour is the obtained product.
3. Yield of edible oil, saponin and chestnut flour at the same time.
4. Yield of a slightly bitter flour for households, containing protein.

Berries of the mountain ash tree have a vitamin C content of 67 - 135 mg/100 g. These berries will be used for production of marmalade. It was stated, that attention must be paid to their storage before manufacture. They must not be stored at refrigeration temperature, nor piled too heavy. In the first case a loss of 50 % vitamin C, in the second case a loss of 30 % of the same vitamin was found. Storage of these berries at common temperature must not exceed 10 days. A favorable storage temperature is 10° C.

The following investigations were made:

Publication on the use of wild vegetables.
Publication on better utilization of mushrooms.
Publication on the utilization of by-products of the dehydration - and preserve plants.
Publication on spoilage control in households.
Report on the use of malt kilns for dehydration of vegetables and potatoes.
Publication on the precautions of producing the highest quality dehydrated vegetables.
Recipes for use of whey in households.
Report on packaging of marmalade.
Recipes for use of rye and coarse rye etc., in households.
Tests for utilization of potato peels.
Tests for utilization of unpeeled oats.
Tests for sugar substitutes, acids and pectin in the manufacture of marmalade.

Register of Publications.

1. R.Heiss: Tests on technical processes in refrigeration and vegetables.(Will be published shortly).
2. F.Kiermeier: Influence of refrigeration temperatures on enzymes. (Will be published shortly).
3. R.Heiss: Test on technical processes for keeping fresh meat in "Supply Technics of Foodstuffs". Publisher: Steinkopff, Dresden, 1944
4. R.Heiss: Transportation of refrigerated food in "Refrigeration Pocket Book", VDI-publisher, Berlin, 1944.
5. F.Herrlinger and F.Kiermeier: Inactivation and regeneration of peroxydase-solutions treated with heat. (Biotechnica. Journal", in print).
6. G.Kaess: Prospects of some additional processes in the storage of eggs in temperatures under continental and tropical conditions, "Magazine for Food Examination and Investigation" 87 (1944), p.112.
7. F.Kiermeier: Basis for the production of preserved bread, in "Shares to Supply-Technics of Foodstuffs", publisher Steinkopff, Dresden, 1944.

8. F.Kiermeier: The autoxydation of emulsified fats, "Bio-Chemical Magazine"
9. G.Kaess: The keeping quality of preserved meat-products, independent upon air conditions, in "Shares to Supply-Technics of Food", publisher Steinkopff, Dresden, 1944.
10. R.Heiss: Instruction for storage of food, publisher Springer, 2. edition 1945.
11. R.Heiss: Determination of the swelling capacity of dehydrated foodstuffs, especially dehydrated vegetables (Magazine "Fruit and Vegetable Utilization Industry" 1943).
12. G.Kaess: The influence of packaging on the keeping-quality of tobacco-products at high temperatures and high relative moisture. Magazine "The Paper Manufacturer" 1945, February.
13. G.Kaess: Packaging of marmalade. Magazine "The paper manufacturer" 1945, (will be published shortly").

Appendix of the annual report.

I. Technics of processes.

R.Heiss Section "Refrigerated transportation" in the "Refrigeration Pocket book", VDI-publisher, Berlin, 1944.

R.Heiss Examination of technical processes about the keeping fresh of meat ("Shares to Supply-Technics of food", publisher Steinkopff, Dresden, p.75).

R.Heiss Tests about the decrease of peeling losses in the manufacture of potatoes ("Applied science in cooking", 3. volume, 1943)

R.Heiss Definition of the swelling capacity of dehydrated food, especially dehydrated vegetables (Magazine "Fruit and Vegetable Utilization Industry" 1943).

R.Heiss and B.Nitsch Tests about the transportation of refrigerated food, ("Magazine for the entire Refrigeration Industry", 50.volume 1943, p.126).

R.Heiss Influence of reftigeration velocity on the quality of fruit and vegetables ("Magazine for the entire refrigeration Industry", 1942, 49, p.142)

R.Heiss Penetration of sugar in quick refrigeration of fruit, (Magazine Horticulture, serving the nutrition during the war" 1943).

R.Heiss Instruction for storage of food, publisher Springer 1942/45.

R. Heiss — Qualification of different packagings in storage of eggs (Magazine for the entire refrigeration Industry, 5o 1943 p.6[illegible])

R.Heiss — Progress in food investigation (Work report about keeping fresh of foodstuffs) publisher Steinkopf Dresden 1942.

II. Additional processes.

G.Kaess — Section "Packagings" in the "Refrigeration Pocket Book", VDI-publisher, Berlin 1944

G.Kaess — Keeping quality of preserved meat products, independent upon air conditions (Shares to Supply-technics of food", publisher Steinkopff, Dresden, p.125).

G.Kaess — The gasrefrigerated storage of eggs (Magazine for the entire refrigeration industry", 1943, 5o, o.1o7 and "Magazine VDI" 88, volume 1944, p. 58o)

G.Kaess — The keeping-quality of eggs, when using additional processes ("Magazine for food examination- and investigation" 87. volume 1944, p.112)

G.Kaess — Refrigerated gas storage of fruit ("Horticulture" 17.volume, part 5, p.591)

G.Kaess — Examination of packaging materials and packagings with regard to their qualification for refrigerated-preserved goods ("The paper Manufacturer" 1943, part 6, p.2o3-215)

G.Kaess — Influence of packaging on the keeping quality of tobacco products at high temperatures and high relative moisture of the air ("Magazine "The paper Manufacturer"), in print)

G.Kaess — Packagings of marmalades ("The paper manufacturer) in print.

J.W.Dijk and G.Kaess — The steam perviousness of waxed papers, with different strong coatings ("The paper Manufacturer", in print).

III. Chemistry.

F.Kiermeier — Section "Fats" and section "Eggs" in the Refrigeration pocket book, VDI-publisher, Berlin 1944.

F.Kiermeier — Manufacture of preserved bread, ("Shares to Supply-technics of food", publisher Steinkopff, Dresden, p. 1).

F.Kiermeier	Definition of the perviousness of aromatic substances in packaging materials ("Chemical technique", 16 years set, 2o, 1943. p.2o4)
F.Kiermeier	Influence of refrigeration temperature on the activity of ferments ("Biochemical Magazine, in print).
F.Kiermeier	Autoxydation of emulsified fats ("Biochemical Magazine, in print)
F.Herrlinger and F.Kiermeier	Inactivation and regeneration of peroxydase-solutions, treated with warmth ("Biochemical Magazine" in print)
A.Patschky and F.Kiermeier	How volatile stuffs can be obtained by extraction and distillation of natural products ("Magazine for analytical Chemistry", in print).

Munich, 3. July 1945.

(He/Wl)

Appendix XXII

About the Maltase of Wheat-and Rye Flour.

By Dr. A. Rotsch.

In the determination of sugar in watery flour-autolysates it was found that not only the maltose content increased with the length of the standing time of the li-quid, but that the glucose content increased also, a fact that had not been given the necessary attention. It was thought, that the increase of glucose in flour-suspensions was caused by the activity of a grain enzyme, called maltase, that had been discovered previously. The experimental studies on this subject were difficult because of the lack of appropriate methods. The small amounts of glucose concentrates in the flour extractions made the sugar separation complicated But at last the choice of appropriate flour floating and an appropriate modification of Barfoed reaction made it possible to watch the increase of the glucose content in flour extractions through reduction of a mixture of blue vitriol and natrium acetate solution (Steinhoff's solution).

For determination of glucose in wheat flour for the first 3 hours a strongly concentrated flour floating was used (3 parts of flour to 5 parts of water), because the glucose concentration in 10 % suspensions, as usually used, was too small, to result a separation of maltose and glucose, by means of Barfoed's reaction.

After 5 to 6 hours the glucose content in these extractions was sufficient to make the determinations.

Rye flour had a far higher glucose content, so that also in 10 % suspensions from the beginning of thedigestion (?) a glucose maltose separation could be made. The following table shows the glucose formation in wheat and rye flour, after 3 hours.

Formation of glucose in wheat-and rye-flour extractions.

Kind of flour	type	glucose content after a standing time of 0	1 hr	2 hrs.	3 hrs.
		in %			
1. wheat flour	812	0.18	0.23	0.30	0.44
2. " "	812	0.15	0.23	0.32	0.46
3. " "	812	0.15	0.25	0.32	0.36
4. " "	812	0.21	0.28	0.36	0.38
1. Rye flour	997	0.46	0.61	0.84	1.00
2. " "	997	0.47	0.64	0.80	1.13
3. " "	997	0.54	0.99	1.23	1.29

In the beginning the glucose content in wheat flour type 812 was in average 0.15 to 0.21 % in rye flour (type 997) 0,43 to 0:48 % and increased after a standing time of 6 hours in wheat flour from 0.74 to 0.93 %, in rye flour from 1.23 to 1.70 %. The glucose content was not influenced during this time by inversion of saccharose, as the saccharose content of the flours remained constant and no free fructose was found. The formation of glucose could only be possible through division of maltose.

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